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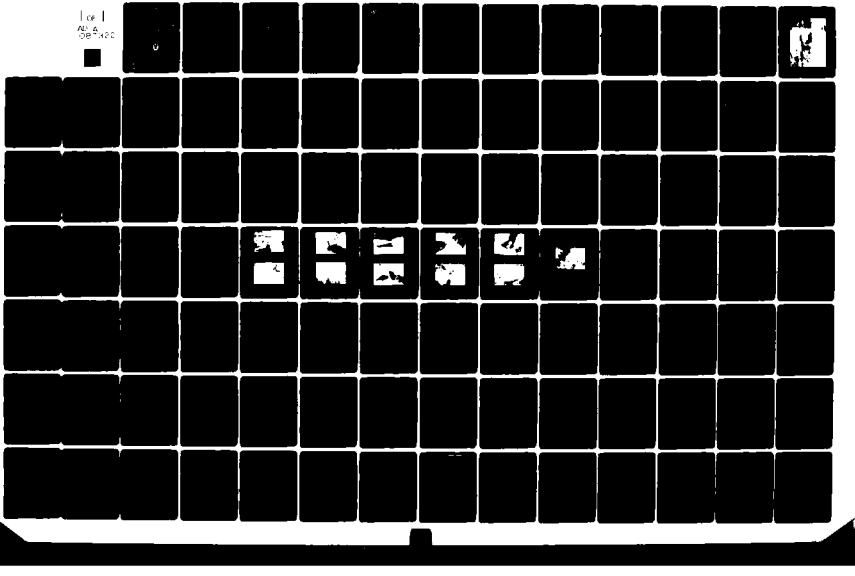

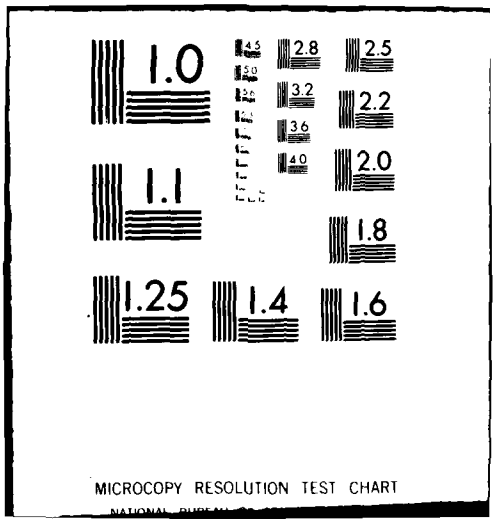
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LEVEL I

AD A087322

PASSAIC RIVER BASIN
TRIBUTARY TO LUBBERS RUN BROOK
SUSSEX COUNTY
NEW JERSEY

JOHNSON LAKE DAM
NJ 00499

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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2. GOVT ACCESSION NO.: AD-A087322
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Phase I Inspection Report
National Dam Safety Program.
Johnson Lake Dam (NJ00499), Passaic River Basin
~~Sussex County, New Jersey~~ Tributary to Lubbers Run Brook, Sussex County, New Jersey. Phase I Inspection Report.

5. TYPE OF REPORT & PERIOD COVERED: FINAL rept.

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7. AUTHOR(s): WARREN A. GUINAN

8. CONTRACT OR GRANT NUMBER(s): DACW61-79-C-0011

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
Anderson-Nichols & Company, Inc.
6 London Road
Concord, N.H. 03301

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:

11. CONTROLLING OFFICE NAME AND ADDRESS:
NJ Department of Environmental Protection
Division of Water Resources
P.O. Box CN029
Trenton, NJ 08625

12. REPORT DATE: January 1980

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Dams	
Embankments	Visual Inspection
Structural analyses	National Dam Safety Program
Safety	Johnson Lake Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

28 JUL 1980

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Johnson Lake Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Johnson Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to seven percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner, using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from date of approval of this report, the following engineering studies and analyses should be initiated:

(1) Design and oversee procedures for repair of erosion of the earth berm on the downstream side of the concrete dam and on the banks of the discharge channel immediately downstream of the stoplog spillway.

(2) Design and oversee the repair of the deteriorated portion of the concrete dam on either side of the stoplog facility.

(3) Design and oversee procedures for making the soil abutments resistant to erosion in the event of overtopping.

(4) Design and oversee procedures for removing the trees on the right abutment.

(5) Determine the configuration and condition of the concrete and earth sections of the dam and its foundation for the purpose of evaluating the stability of the structure.

(6) Repair eroded and spalled areas of the joint 10 feet to the right of the stoplog section, and monitor lateral movement. If movement progresses, design and implement remedial measures.

c. Within six months from the date of approval of this report, the following actions should be initiated:

(1) Clear brush and trees from the banks of the discharge channel between the dam and the highway culvert immediately downstream of the dam.

(2) Establish a surveillance program for use during and immediately after periods of heavy rainfall, and also a warning program to follow in case of emergency conditions.

(3) Restore or replace the gate operating mechanism for the low-level outlet.

d. Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

NAPEN-N
Honorable Brendan T. Byrne

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

JOHNSON LAKE DAM (NJ00499)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 5 November 1979 by Anderson-Nichols & Co., Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Johnson Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to seven percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner, using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within six months from date of approval of this report, the following engineering studies and analyses should be initiated:

(1) Design and oversee procedures for repair of erosion of the earth berm on the downstream side of the concrete dam and on the banks of the discharge channel immediately downstream of the stoplog spillway.

(2) Design and oversee the repair of the deteriorated portion of the concrete dam on either side of the stoplog facility.

(3) Design and oversee procedures for making the soil abutments resistant to erosion in the event of overtopping.

(4) Design and oversee procedures for removing the trees on the right abutment.

(5) Determine the configuration and condition of the concrete and earth sections of the dam and its foundation for the purpose of evaluating the stability of the structure.

(6) Repair eroded and spalled areas of the joint 10 feet to the right of the stoplog section, and monitor lateral movement. If movement progresses, design and implement remedial measures.

c. Within six months from the date of approval of this report, the following actions should be initiated:

(1) Clear brush and trees from the banks of the discharge channel between the dam and the highway culvert immediately downstream of the dam.

(2) Establish a surveillance program for use during and immediately after periods of heavy rainfall, and also a warning program to follow in case of emergency conditions.

(3) Restore or replace the gate operating mechanism for the low-level outlet.

d. Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

APPROVED: _____
JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 24 Jun 1980

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Johnson Lake Dam
Identification No.:	FED ID No. NJ00499
State Located:	New Jersey
County Located:	Sussex
Stream:	Tributary to Lubbers Run
River Basin:	Passaic
Date of Inspection:	November 5, 1979

ASSESSMENT OF GENERAL CONDITIONS

Johnson Lake Dam is 36 years old and in fair overall condition. It is small in size and is recommended to be downgraded to Significant Hazard. The crest of the dam is of concrete which was casted irregularly and is very rough. Large trees are located on the right (west) abutment. The joint in the concrete wall on the right side of the stoplogs is eroded and some movement was observed. The joint located 10 feet to the right of the stoplog section is eroded and spalled and there is indication of some lateral movement. Erosion of the earth berm has occurred on the downstream side of the concrete dam. The downstream face of the dam is badly spalled at the base adjacent to the stoplog section and the reinforcing steel is exposed on the right side of the stoplogs. The downstream concrete discharge chute is surface eroded. Brush and a few trees are growing in the downstream channel. The spillway can pass approximately 6 percent of the selected ½ PMF SDF or 3 percent of the PMF and is inadequate.

It is recommended that the owner retain the services of a professional engineer, qualified in the design and construction of dams, to accomplish the following in the future: design and oversee procedures for repair of erosion of the earth berm on the downstream face of the concrete dam and on banks of the discharge channel immediately downstream of the stoplogs; design and oversee the repair of the deteriorated portions of the concrete dam on either side of the stoplog section; repair eroded and spalled areas of the joints located 10' to the right of the stoplog section and monitor lateral movement. If movement progresses, design and implement remedial measures; design and oversee procedures for making the soil abutments resistant to erosion in the event of overtopping; design and oversee procedures for removing the trees and their root systems on the right abutment; and conduct a more detailed hydrologic and hydraulic analysis of the spillway to determine the extent and type of remedial measures necessary.

It is further recommended that the owner accomplish the following tasks as a part of operating and maintenance procedures: in the near future, clear brush and trees from the banks of the discharge channel between the dam and the highway culvert immediately downstream of the dam; establish a surveillance program for use during

and immediately after periods of heavy rainfall, and also a warning program to follow in case of emergency; and restore or replace the gate operating mechanism for the low-level outlet. Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.

ANDERSON-NICHOLS & COMPANY, INC.

Warren A. Guinan

Warren A. Guinan, P.E.
Project Manager
New Jersey No. 16848

5 NOV 1979

OVERVIEW

JOHNSON LAKE DAM

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY REPORT

JOHNSON LAKE DAM FED ID NO. NJ00499

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
JOHNSON LAKE DAM
FED ID NO. NJ00499

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Johnson Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 26 October 1979 under Contract FPM No. 39, dated 28 June 1979. This authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 5 November 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to safety of Johnson Lake Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations, and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Johnson Lake Dam is a 42-foot long concrete and earth embankment dam with a concrete core and a hydraulic height (also structural height) of 11.3 feet. The downstream face is of concrete and earth with a 3H:1V slope. A 4-foot long stoplog principal spillway is located on the southeastern (left) part of the dam. The wooden stoplogs are 2 inches thick and total 3.5 feet in height. The stoplogs are held in place by concrete slots. The 10-foot long concrete free overflow spillway is near the center of the dam and has a topwidth of 1 foot. A 2-foot diameter concrete pipe (low-level outlet) approximately 20 feet long is located about 7.2 feet below the principal spillway invert. Essential features of the dam are given in Figure 1.

b. Location. Johnson Lake Dam is located in Sussex County, New Jersey on a tributary to Lubbers Run, approximately 3 miles north of Lockwood. It is at north latitude 40° 57.6' and west longitude 74° 43.6' A location map is given in Figure 2.

c. Size Classification. Johnson Lake Dam is classified as being "small" on the basis of storage at the dam crest of 215 acre-feet, which is less than 1000 acre-feet but more than 50 acre-feet,

and on the basis of its height of 11.3 feet, which is less than 40 feet, in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Visual inspection of the downstream area showed that failure of Johnson Lake Dam could possible cause damage to 3 residences; but the breach analysis contained herein indicates that only one of the 3 houses could be severely damaged by about 5.5 feet of water. Accordingly, Johnson Lake Dam is classified as Significant Hazard.

e. Ownership. The dam is owned by Resource Recovery Associates, Totawa, New Jersey 07512. Mr. Arthur Hart was contacted for information, (201) 256-6330.

f. Purpose of Dam. The lake is used for recreation.

g. Design and Construction History. Little information was found regarding the design and construction of the dam.

h. Normal Operational Procedures. No operational procedures were revealed.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. Information derived from a Geologic Map of New Jersey (Lewis and Kummel, 1912) indicates that soils within the immediate site area consist of ground moraine overlying bedrock.

Bedrock was observed in sporadic outcrops at the reservoir perimeter during inspection of this dam. The previously mentioned map indicates that bedrock in this area consists of granitoid gneiss of Precambrian age.

1.3 Pertinent Data

a. Drainage Area

Watershed - 0.6 square mile

Normal water surface - 33 acres

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown

Ungated (total) spillway capacity at maximum pool elevation-28

Low-level outlet (if operable) - 58

c. Elevation (NGVD)

Top of dam - 837.4

Recreation pool - 837

Overflow spillway crest - 837

Principal spillway crest - 836.7 with stoplogs

- 833.2 stoplogs removed

Streambed at centerline of dam - 826.1

Maximum tailwater (estimated) - 827.3

d. Reservoir (feet)

Length of maximum pool - 2765

Length of recreational pool - 2700

e. Storage (acre-feet)

Recreation pool - 198

Design surcharge - (½ PMF) - 338

Top of dam - 215

f. Reservoir Surface (acres)

Top of dam - 37

Recreation pool - 33

Overflow spillway crest - 33

g. Dam

Type - earthfill and concrete

Length - 42 feet

Height - 11.3 feet

Topwidth - 1 foot

Side slopes - upstream unknown, downstream 3H:1V

Zoning - earthfill downstream face with concrete core which serves as upstream face

Impervious core - concrete

Cutoff - unknown

Grout curtain - unknown

h. Spillway

Type - concrete overflow spillway

Length of weir - free overflow spillway: 10 feet

- stoplog principal spillway: 4 feet

Crest elevation - free overflow spillway: 837' NGVD

- stoplog principal spillway: 836.7' NGVD

Gates - stoplogs

Upstream channel - Johnson Lake (no approach channel)

Downstream channel - tributary to Lubbers Run

i. Regulating Outlets

Type - one two-foot diameter concrete low-level outlet pipe

Length (estimated) - 20'

Access - not visible

Regulating facilities - none found

SECTION 2
ENGINEERING DATA

2.1 Design

No plans, hydraulic or hydrologic data for Johnson Lake Dam were found.

2.2 Construction

No data concerning construction of Johnson Lake Dam were found.

2.3 Operation

No engineering operational data were found.

2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection files, and contact with the owner revealed no recorded information.

b. Adequacy. Because of lack of available recorded data, evaluation of this dam was based solely on visual inspection.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. Dam. Some erosion has taken place in the earth berm next to the downstream side of the concrete dam between the spillway and both abutments. Soil is exposed at both abutments and the ground elevation at the abutments is only slightly higher than the crest of the concrete dam. Two pine trees are growing near the right abutment. No leakage under the dam or through the abutments was observed; because water was discharging over the stoplog spillway at the time of the inspection it was not possible to examine for seepage at the spillway location.

b. Appurtenant Structures. The concrete portion of the dam was cast irregularly and the top of the concrete wall is very rough. The steel bars embedded in the top of the wall are rusted. The downstream face of the dam is badly spalled at the base adjacent to the wooden stoplogs. Reinforcing steel is exposed on the right side of the stoplog section. The low-level outlet gate was not visible at the time of the inspection.

The joint in the concrete wall approximately 10 feet to the right of the stoplog section is eroded and spalled, some movement was observed. The downstream concrete discharge chute is surface eroded, exposing the coarse aggregate.

c. Reservoir Area. The watershed above the reservoir is gently to steeply sloping and partly wooded. Slopes adjacent to the reservoir appear to be stable. No structures were observed close to the shore of the reservoir. Sediment has accumulated behind the dam to within one foot of the crest. No evidence of significant sedimentation other than that close to the dam was observed.

d. Downstream Channel. Brush is growing on the left side and there are a few small trees on the right side of the downstream channel between the dam and the highway culvert immediately downstream of the dam. Downstream of the highway culvert, many trees overhang the channel. Macadam has been crudely placed on the right bank of the downstream channel close to the stoplog spillway apparently for the purpose of controlling erosion of the channel bank.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were found.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were found.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were found.

4.4 Warning System

No description of any warning system was found.

4.5 Evaluation of Operational Adequacy

Because of the lack of operational and maintenance procedures, the remedial measures described in Section 7.2 should be implemented as prescribed.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. Since no data were revealed an evaluation could not be performed.

b. Experience Data. No experience data were found.

c. Visual Observation. The channel immediately downstream of the dam has been paved either because of previous damage due to excessive discharge and very likely overtopping, or as a future protection measure. At the time of inspection, about one inch of water was passing over the free overflow spillway crest.

d. Overtopping Potential. The hydraulic/hydrologic evaluation for Johnson Lake Dam is based on a Spillway Design Flood (SDF) equal to one-half the Probable Maximum Flood (PMF) in accordance with the range of floods given in the evaluation guidelines for dams classified as Significant Hazard and small in size. The PMF has been determined by application of the SCS Dimensionless Unit Hydrograph procedure to a 24-hour Probable Maximum storm of 22 inches. Hydrologic computations are given in Appendix 3. The routed half-PMF peak discharge for the subject watershed is 648 cfs.

The minimum elevation of the dam allows 0.4 feet of depth in the overflow spillway before overtopping occurs. Under this head the spillway capacity is 28 cfs, which is less than the required SDF.

Flood routing calculations indicate that Johnson Lake Dam will be overtopped for more than 14 hours to a maximum depth of 1.8 feet under half-PMF conditions. It is estimated that the spillway can only pass about 3 percent of the PMF without overtopping the dam.

Because the dam was classified as high hazard during the visual inspection the increase in downstream hazard under breach conditions was assessed. The results of this analysis indicated that only one house would be severely damaged under breach or non-breach conditions. Thus, the hazard classification was reduced from high to significant. The spillway can pass less than 50 percent of the PMF and is deemed inadequate.

e. Drawdown Capability. Assuming that the low-level outlet currently in place can be restored to an operable condition, it is estimated that the lake can be drained in approximately 3 days, assuming no significant inflow. This is considered adequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Visual Observations

Erosion of the earth berm against the downstream side of the concrete dam, if not controlled, will reduce the stability of the dam by removal of the earth support. The soil exposed at the abutments is susceptible to erosion if the dam is overtopped, and this erosion, in turn, could result in loss of abutment support and consequent failure of the dam. If one of the trees growing on the right abutment blows over and pulls out its roots, or if one of the trees die and its roots rot, serious seepage and erosion problems may result. Significant spalling of the concrete at the base of the walls adjacent to the stoplogs could cause a release of the stoplog at the bottom of the wall and result in unplanned draining of the lake.

Based on the visual inspection alone it is not possible to determine the geometry of the concrete dam beneath the ground surface or the character of the foundation. Therefore, it is not possible to evaluate the factor of safety of the dam against sliding or overturning.

6.2 Design and Construction Data

No design or construction data pertinent to the structural stability of the dam are available.

6.3 Operating Records

No operating records pertinent to the structural stability of the dam are available.

6.4 Post-Construction Changes

No records pertinent to post-construction changes are available.

6.5 Seismic Stability

This dam is in Seismic Zone 1. According to the Recommended Guidelines, dams located in Seismic Zone 1 "may be assumed to present no hazard from earthquake provided static conditions are satisfactory and conventional safety margins exist." None of the visual observations made during the inspection are indicative of unstable slopes. However, because no data are available concerning the engineering properties of the embankment and foundation materials for this dam or of the below-ground configuration of the concrete wall in the dam, it is not possible to make an engineering evaluation of the stability of the slopes or the factor of safety under static conditions.

SECTION 7
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Johnson Lake Dam is of undetermined age and is in fair overall condition.

b. Adequacy of Information. Since there is a lack of recorded information the assessment of the dam is based on the results of the visual inspection.

c. Urgency. The recommendations made in 7.2 a. and 7.2 c. should be implemented by the owner as prescribed below.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems which are listed in 7.2 a. below. These problems require the attention of a professional engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to instability of the structure.

7.2 Recommendations/Remedial Measures

a. Recommendations. The owner should retain a professional engineer qualified in the design and construction of dams to accomplish the following in the near future:

(1) Design and oversee procedures for repair of erosion of the earth berm on the downstream side of the concrete dam and on the banks of the discharge channel immediately downstream of the stoplog spillway.

(2) Design and oversee the repair of the deteriorated portion of the concrete dam on either side of the stoplog facility.

(3) Design and oversee procedures for making the soil abutments resistant to erosion in the event of overtopping.

(4) Design and oversee procedures for removing the trees and their root systems on the right abutment.

(5) Conduct a more detailed hydrologic and hydraulic analysis of the spillway to determine the extent and type of remedial measures necessary.

(6) Determine the configuration and condition of the concrete and earth sections of the dam, and the foundation conditions, for the purpose of evaluating the stability of the dam.

(7) Repair eroded and spalled areas of the joint 10 feet to the right of the stoplog section, and monitor lateral movement. If movement progresses, design and implement remedial measures.

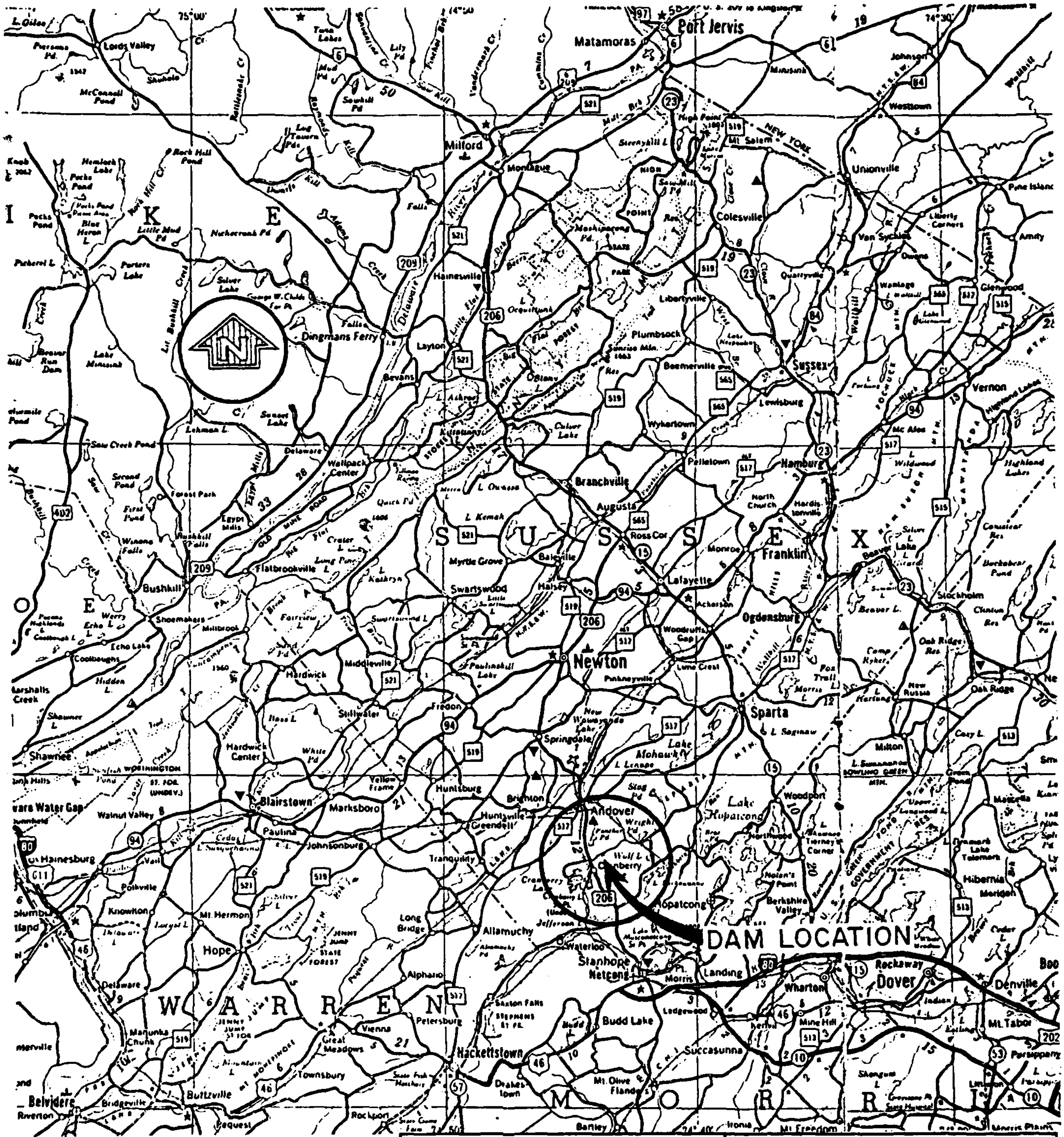
b. Operating and Maintenance Procedures. The owner should do the following in the near future:

(1) Clear brush and trees from the banks of the discharge channel between the dam and the highway culvert immediately downstream of the dam.

(2) Establish a surveillance program for use during and immediately after periods of heavy rainfall, and also a warning program to follow in case of emergency conditions.

(3) Restore or replace the gate operating mechanism for the low-level outlet.

Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam.



SCALE IN MILES

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MAP BASED ON STATE OF NEW JERSEY OFFICIAL HIGHWAY MAP AND GUIDE.

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIST. PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

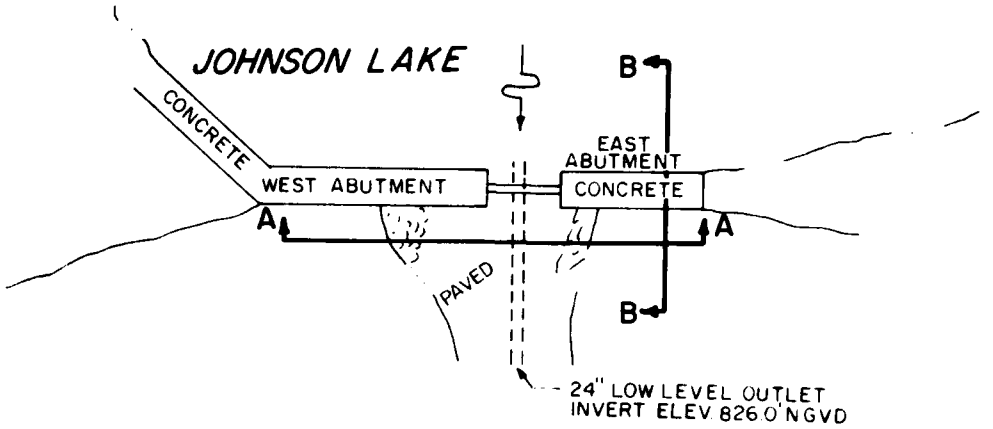
JOHNSON LAKE DAM LOCATION MAP

TRIBUTARY TO LUBBERS RUN BROOK — NEW JERSEY

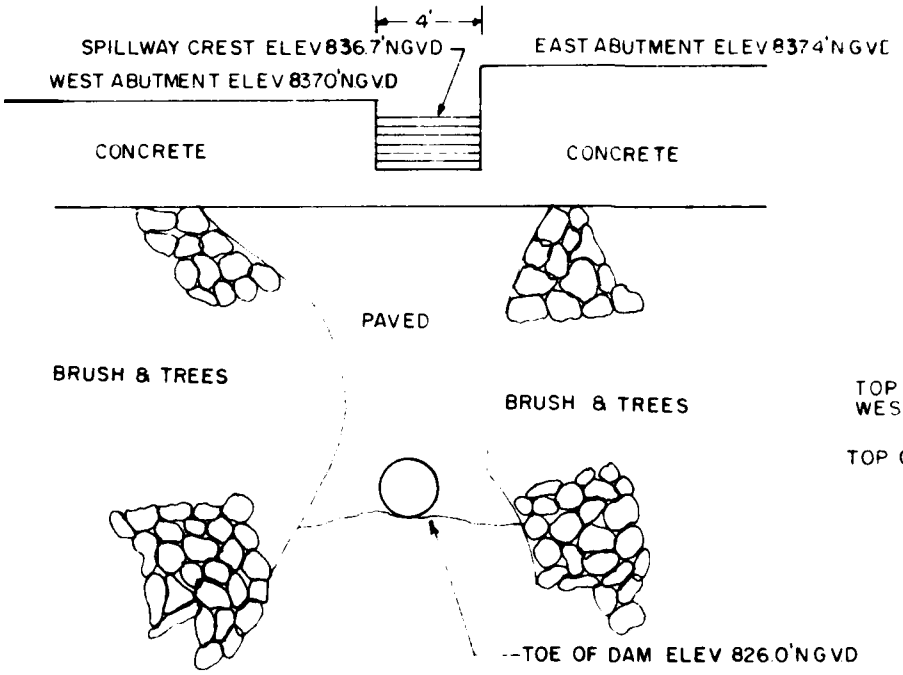
SCALE: SEE BAR SCALE

DATE: JANUARY 1980

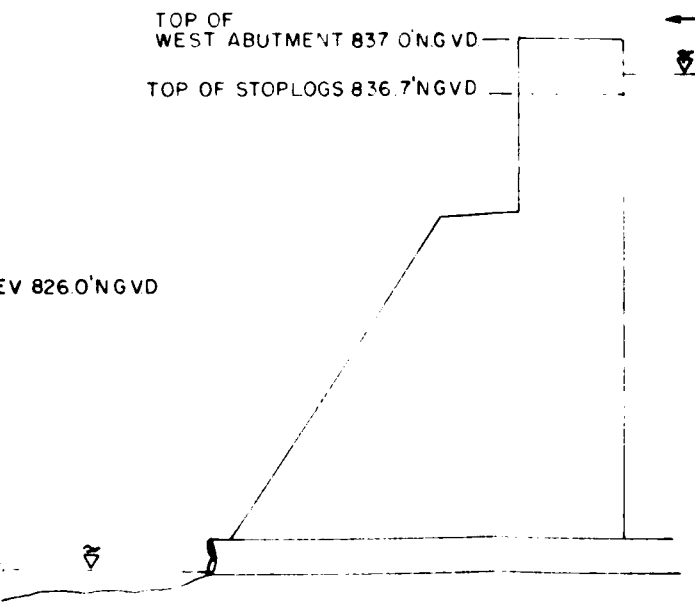
FIGURE 2



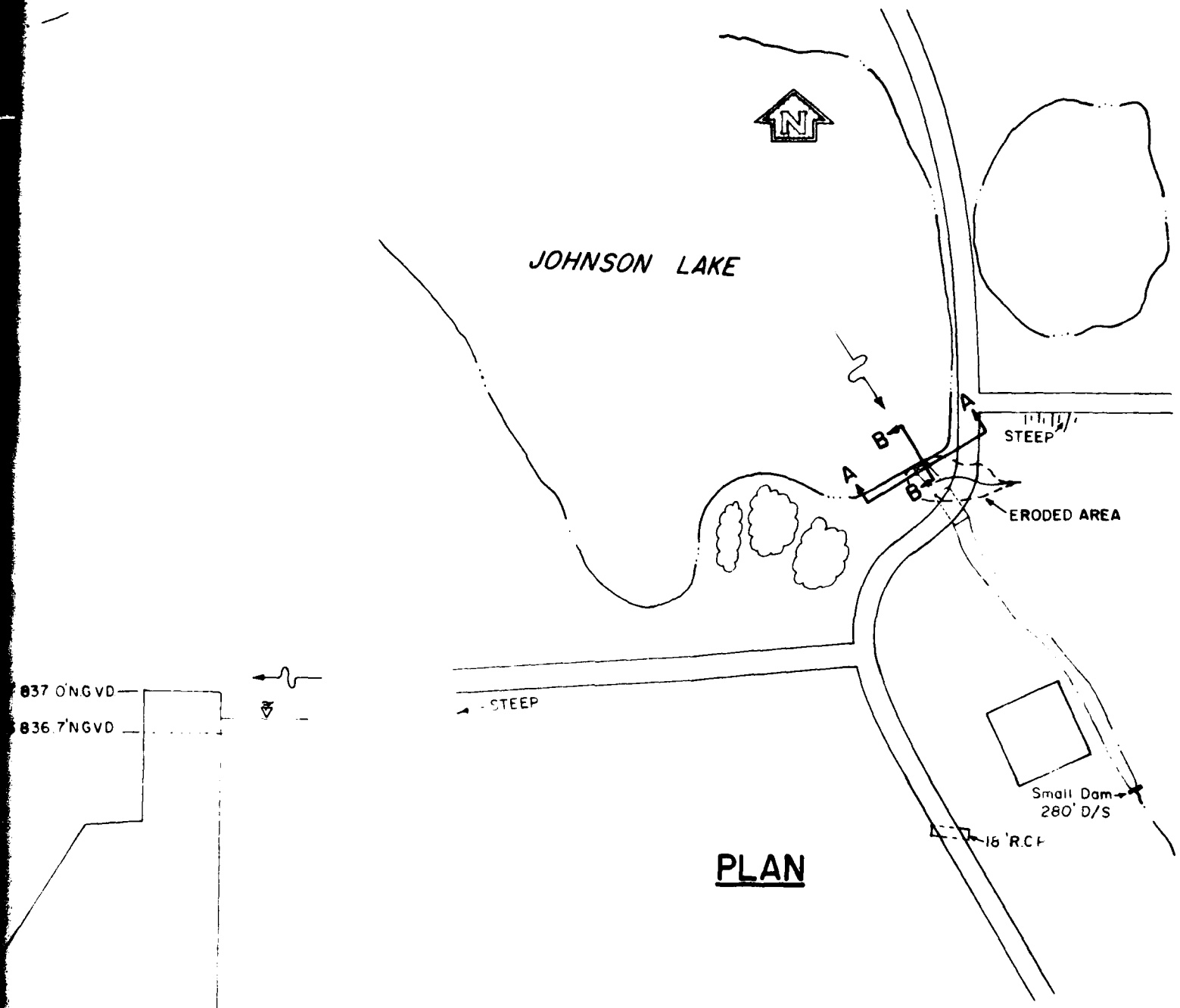
SPILLWAY DETAIL



ELEVATION A-A



SECTION B-B



PLAN

TION B-B

Anderson - Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIST PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

JOHNSON LAKE DAM

TRIBUTARY TO LUBBERS RUN BROOK NEW JERSEY

			SCALE: NOT TO SCALE
			DATE: JANUARY 1980

APPENDIX I

VISUAL INSPECTION

CHECKLIST

JOHNSON LAKE DAM

Check List
Visual Inspection
Phase 1

Name Dam Johnson Lake Dam County Sussex State N.J. Coordinators NJDEP

Date(s) Inspection Nov. 5, 1979 Weather Sunny, cool Temperature 62°

Pool Elevation at Time of Inspection 837.0 NGVD Tailwater at Time of Inspection 827.3 NGVD

Inspection Personnel:

Warren Guinan — Ronald Hirschfeld

Stephen Gilman

Kenneth Stuart

Gilman/Hirschfeld Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	No seepage or leakage.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Some erosion of soil from against downstream side of concrete dam near both abutments.	Eroded areas should be repaired and protected against further erosion.
DRAINS	None observed.	
WATER PASSAGES	None observed.	
FOUNDATION	Unknown. Soil exposed at both abutments. Rock exposed in right bank of reservoir immediately upstream of dam appears to be bedrock.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	- top of concrete eroded to expose coarse aggregate - one large spalled erosion area at downstream face adjacent to stoplog on both sides.	Engage engineer to design and implement repairs.
STRUCTURAL CRACKING	None	
VERTICAL AND HORIZONTAL ALIGNMENT	- Poor - Wall thickness varies	
MONOLITH JOINTS		
CONSTRUCTION JOINTS	Joint 10' . Right of stoplog is eroded and spalled. Some lateral movement observed.	Repair eroded and spalled areas. Monitor lateral movement. If movement progresses design and implement remedial measures.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Some reinforcing steel visible. Concrete spalled at base of wall adjacent to stoplog section. Some vertical movement observed.	Repair deteriorated concrete. Watch for changes in vertical alignment.
APPROACH CHANNEL	See gated spillway.	
DISCHARGE CHANNEL	See gated spillway.	
BRIDGE AND PIERS OVER SPILLWAY	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not applicable	
INTAKE STRUCTURE	Not visible	
OUTLET PIPE	- 24" RCP - only the end of the pipe is visible - fair condition	
OUTLET CHANNEL	Trees overhanging channel. Brush on banks of channel.	Trees and brush should be cleared from banks of channel between dam and highway culvert immediately downstream. Banks should be maintained free of brush.
EMERGENCY GATE	Not applicable	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not visible	
APPROACH CHANNEL	None - body of lake directly upstream	
DISCHARGE CHANNEL	Concrete chute surface eroded to expose coarse aggregate.	Repair eroded concrete surfaces.
BRIDGE AND PIERS	None	
GATES AND OPERATION EQUIPMENT	None	
STOPLOGS	2" weathered wood	Check condition of wood periodically, and replace as necessary.

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	None observed.	
PIEZOMETERS	None observed.	
OTHER	None observed.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gently to steeply sloping. No evidence of instability observed.	
SEDIMENTATION	Sediment has accumulated to elevation of bottom of stoplog spillway and to within one foot of crest of dam between stoplog spillway and abutments.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Brush and small trees overhanging	Remove trees and brush which may fall and block channel.
SLOPES	Moderately sloping	
APPROXIMATE NO. OF HOMES AND POPULATION	Three homes, estimated population of ten.	Only one home approximately 250' downstream will be affected by discharges from the dam.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	None found.
REGIONAL VICINITY MAP	Prepared for this report.
CONSTRUCTION HISTORY	None found.
TYPICAL SECTIONS OF DAM	None.
HYDROLOGIC/HYDRAULIC DATA	None.
OUTLETS - PLAN	None.
- DETAILS	None revealed
- CONSTRAINTS	None found.
- DISCHARGE RATINGS	None revealed
RAINFALL/RESERVOIR RECORDS	None found

ITEM	REMARKS
DESIGN REPORTS	None found
GEOLOGY REPORTS	None revealed
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None found.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None found
POST-CONSTRUCTION SURVEYS OF DAM	None revealed
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SERVICES	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS	Prepared for this report from field inspection.
DETAILS	None.
OPERATING EQUIPMENT	None.
PLANS & DETAILS	None.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Mountainous, heavy forest

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 837' NGVD (198)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not applicable

ELEVATION MAXIMUM DESIGN POOL: 839.2' NGVD

ELEVATION TOP DAM: 837.4' NGVD

CREST: Free overflow concrete capped spillway.

a. Elevation 837' NGVD

b. Type Concrete weir

c. Width 1 foot

d. Length 10 feet

e. Location Spillover Right side of the dam

f. Number and Type of Gates Unknown

OUTLET WORKS: Low-level outlet pipe

a. Type 24-inch diameter concrete pipe

b. Location Center of the dam

c. Entrance Inverts Unknown

d. Exit Inverts 826.1' NGVD

e. Emergency Draindown Facilities None

HYDROMETEORLOGICAL GAGES: None

a. Type

b. Location

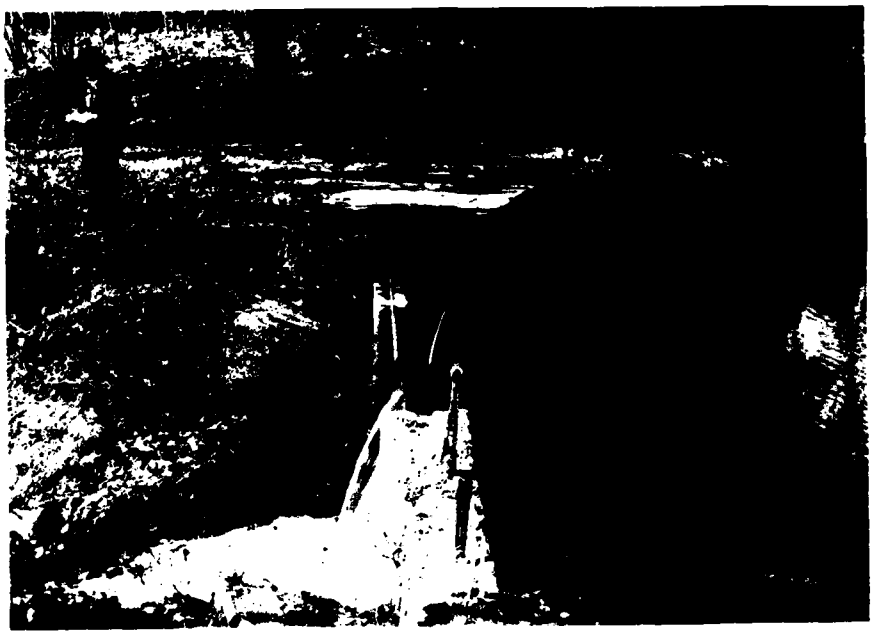
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 28 cfs

APPENDIX 2

PHOTOGRAPHS

JOHNSON LAKE DAM



5 NOV 1979
View of the dam from left abutment looking northwest.

5 NOV 1979
View of the dam from right abutment looking southeast.

5 NOV 1979
View of the downstream face of the stoplog principal spillway.

5 NOV 1979
Upstream face of the dam from right abutment.

NOV 1979
View of the upstream reservoir from spillway crest.

5 NOV 1979
View of the downstream face of the dam looking toward right abutment.

5 NOV 1979
Erosion of concrete on downstream face of the dam next to the stoplog principal spillway.

5 NOV 1979
View of the dam from downstream channel looking upstream.

5 NOV 1979
View of the low-level outlet pipe.

5 NOV 1979
Culvert located 30 feet downstream of the dam.

5 NOV 1979
View of the dam located 280 feet downstream of the dam.

APPENDIX 3

HYDROLOGIC COMPUTATIONS

JOHNSON LAKE DAM

SQUARES 1/4 IN. SCALE

HYDROLOGIC COMPUTATIONS

NAME: JOHNSON LAKE DAM

LOCATION: SUSSEX COUNTY, N.J.

DRAINAGE AREA: 0.6 MI^2

SURFACE AREA (NORMAL POOL): 33 AC

EVALUATION CRITERIA:

SIZE: SMALL

HAZARD: SIGNIFICANT

SPILLWAY DESIGN FLOOD: BASED ON SIZE AND CLASSIFICATION, THE SPILLWAY DESIGN FLOOD WILL BE THE ½ PMF (½ THE PROBABLE MAXIMUM FLOOD) WITH A PEAK INFLOW OF 1471 CFS.

NOTE: DRAINAGE AREA AND SURFACE AREA OF JOHNSON LAKE WERE PLANIMETERED.

Anderson-Nichols & Company, Inc.

Subject JOHNSON LAKE DAM

Sheet No. 2 of

Date 11-21-79

Computed MNM

Checked FDD

JOB NO.

SQUARES 1/4 IN. SCALE

TIME OF CONCENTRATION

OVERLAND FLOW:

LENGTH OF FLOW = 4300 Ft

HEAD = 1200 - 837 = 363 Ft

$$SLOPE = \frac{363}{4300} = 0.084$$

1 - SCS TR #55 METHOD

FROM FIG. 3-1, PAGE 3-2

VELOCTY = 0.72 Ft/Sec

$$T_c = \frac{4300 \text{ Ft}}{0.72 \frac{\text{Ft}}{\text{Sec}}} = 5972 \text{ Sec} = 100 \text{ Min}$$

2 - SOIL & WATER CONSERVATION ENGINEERING METHOD

$$L = 0.6 T_c$$

$$L = \frac{\ell^{0.8} (S+1)^{1.67}}{9000\, y^{0.5}}$$

$$S = \frac{1000}{CN} - 10$$

TAKE CN = 70 FOR WOODS

$$S = \frac{1000}{70} - 10 = 4.3$$

$\ell = 4300$ Ft

$y = 8.4\%$

$$L = \frac{(4300)^{0.8}(4.3+1)^{1.67}}{9000(8.4)^{.5}} = 0.5 \text{ hrs}$$

$$T_c = \frac{0.5}{0.6} = 0.83 \text{ hrs} = \underline{50 \text{ Min}}$$

3 - KERBY METHOD

$$T_c = 0.83\left(\frac{NL}{\sqrt{S}}\right)^{0.467}$$

$L = 4300$ Ft

N = RETARDENCE ROUGHNESS COEFF. = 0.6

$S = 0.084$

$$T_c = 0.83\left[\frac{(0.6)(4300)}{\sqrt{0.084}}\right]^{0.467}$$

$T_c = \underline{58 \text{ Min}}$

4 - TEXAS HIGWAY VELOCITY DATA METHOD

SLOPE = 8.4 %

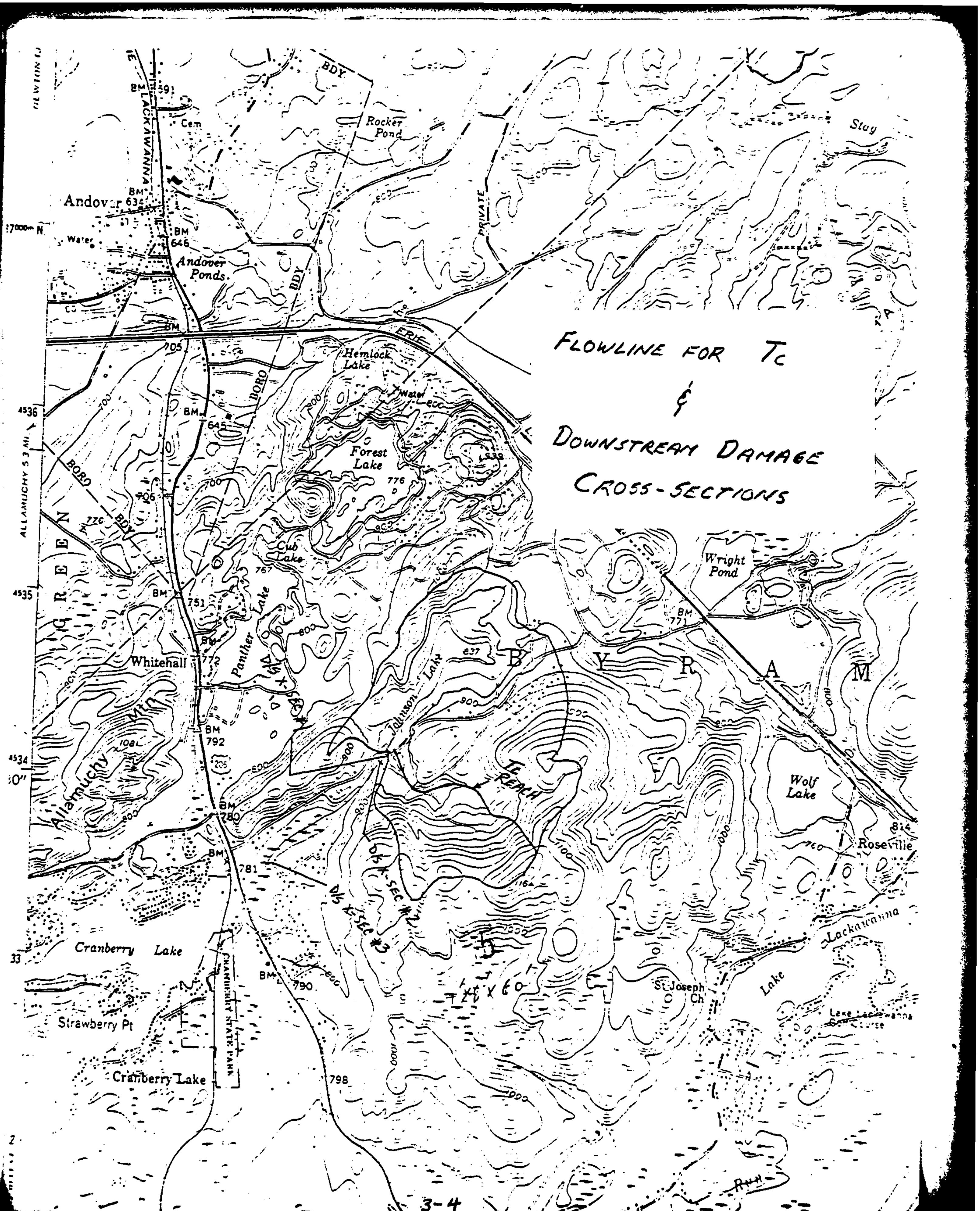
ESTIMATED VELOCITY = 3 FT/Sec

$$T_c = \frac{4300 \text{ Ft}}{3 \text{ Ft/Sec}} = 1433 \text{ Sec} = 24 \text{ Min}$$

$$\text{Average } T_c = \frac{100+50+58+24}{4}$$

Average T_c = 58 Min

LAG TIME = 0.6(58) = 35 Min = 0.58 hrs


FLOWLINE FOR T_c
&
DOWNSTREAM DAMAGE
CROSS-SECTIONS
Andover
Andover Ponds
Rocker Pond
Hemlock Lake
Forest Lake
Cub Lake
Panther Lake
Johnson Lake
Wright Pond
Wolf Lake
Roseville
Whitehall
Allamuchy Mtn
Cranberry Lake
Strawberry Pt
St Joseph Ch
Lackawanna
Lake
B Y R A M
G R E E N
BORO BDY
ERIE
LACKAWANNA
PRIVATE
Stag
T_c REACH
D/S X-SEC #1
D/S X-SEC #2
D/S X-SEC #3
ALLAMUCHY 5.3 MI.
CRANBERRY STATE PARK
BM 705
BM 645
BM 751
BM 772
BM 792
BM 780
BM 781
BM 790
BM 771

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Subject JOHNSON LAKE DAM

Sheet No. 1 of

Date 11-21-79

Computed MNM

Checked EOD

JOB NO. 3409-14

SQUARES 1/4 IN. SCALE

DEVELOPMENT OF RATING CURVE

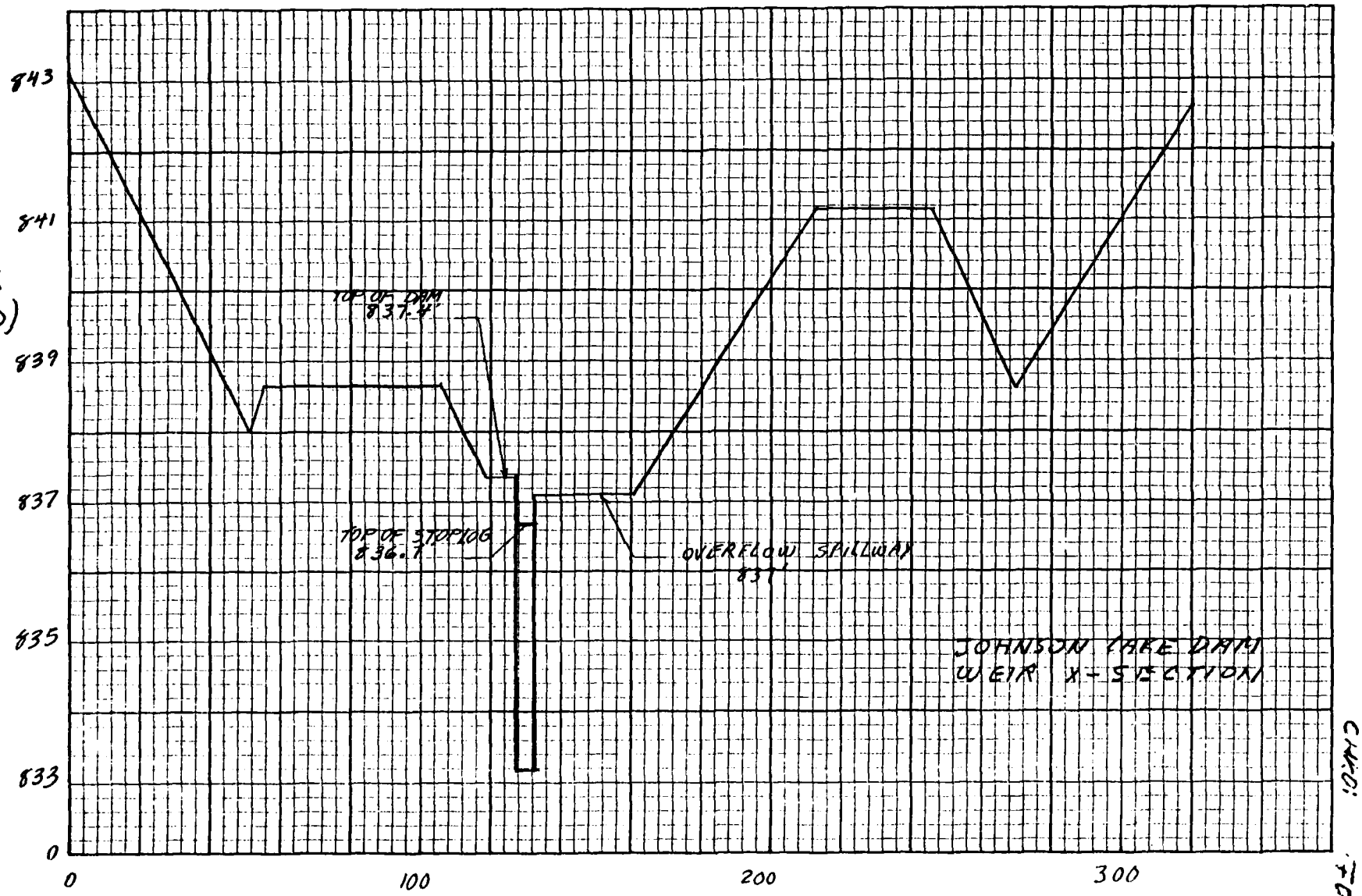
USE WEIR EQUATION $Q = C L H^{3/2}$ TO DETERMINE THE RATING CURVE, WHERE

*C = 3.5 FOR 2" THICK STOPLOGS

C = 2.6 FOR WOODED EMBANKMENT

C = 2.9 FOR CONCRETE SECTION

*"C" VALUES ARE TAKEN FROM BRATER & KING "HANDBOOK OF HYDRAULICS" PAGE 5-40, TABLE 5-3.



3-6

COMPUTED: MMM
CHKD: TOD

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Subject

Sheet No. ____ of ____

Date 11-22-79

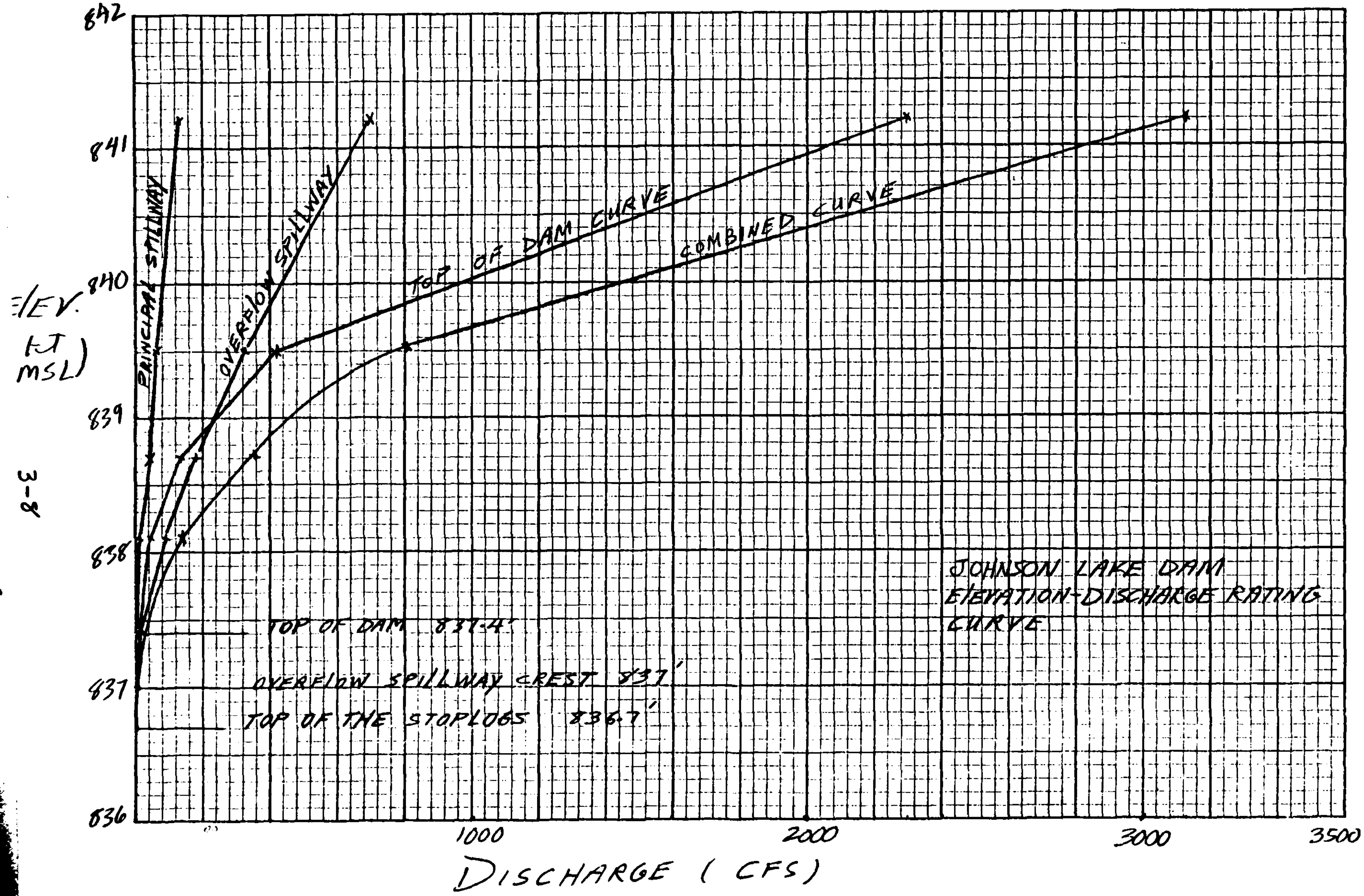
Computed

Checked

JOB NO.

ELEVATION FT.	PRINCIPAL SPILLWAY (WITH STOPLOGS) HEAD FT	PRINCIPAL SPILLWAY (WITH STOPLOGS) Q CFS	OVERFLOW SPILLWAY HEAD FT	SECTION Q CFS	TOP OF DAM LENGTH FT	TOP OF DAM HEAD FT	TOP OF DAM Q CFS	COMBINED Q CFS
836.7	0	0						0
837	0.3	2.3	0	0				2.30
837.4	0.7	8.0	0.4	20	10	0	0	28
838.1	1.4	10	1.1	94	21	0.84	42	146
838.7	2.0	40	1.7	180	40	1.2	137	357
839.5	2.8	66	2.5	321	73	1.7	421	808
841.2	4.5	134	4.2	700	170	3.0	2297	3131

COMPUTED: MNM
CHKD: FOD



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Subject JOHNSON LAKE DAM

Sheet No. 1 of

Date 11-23-79

Computed MM

Checked FDD

JOB NO. 3409-14

SQUARES 1/4 IN. SCALE

STORAGE - ELEVATION DETERMINATION

ASSUME AN AVERAGE DEPTH OF 6'

ASSUME A MAXIMUM DEPTH OF 11'

ELEVATION FT	SURFACE AREA ACRES	AVE. S.A. ACRES	INCREMENTAL STORAGE AC-FT	CUMULATIVE STORAGE AC-FT
		33	198	198
837	33			
		48	144	342
840	63			
		69.5	1390	1732
860	76			
		87.5	1750	3482
880	99			

INPUT FOR HEC-1 (FROM CURVE)

ELEVATION FT.	STORAGE AC-FT
825.7	0
836.7	170
837	198
837.4	215
838.1	240
838.7	270
839.5	375
841.2	425

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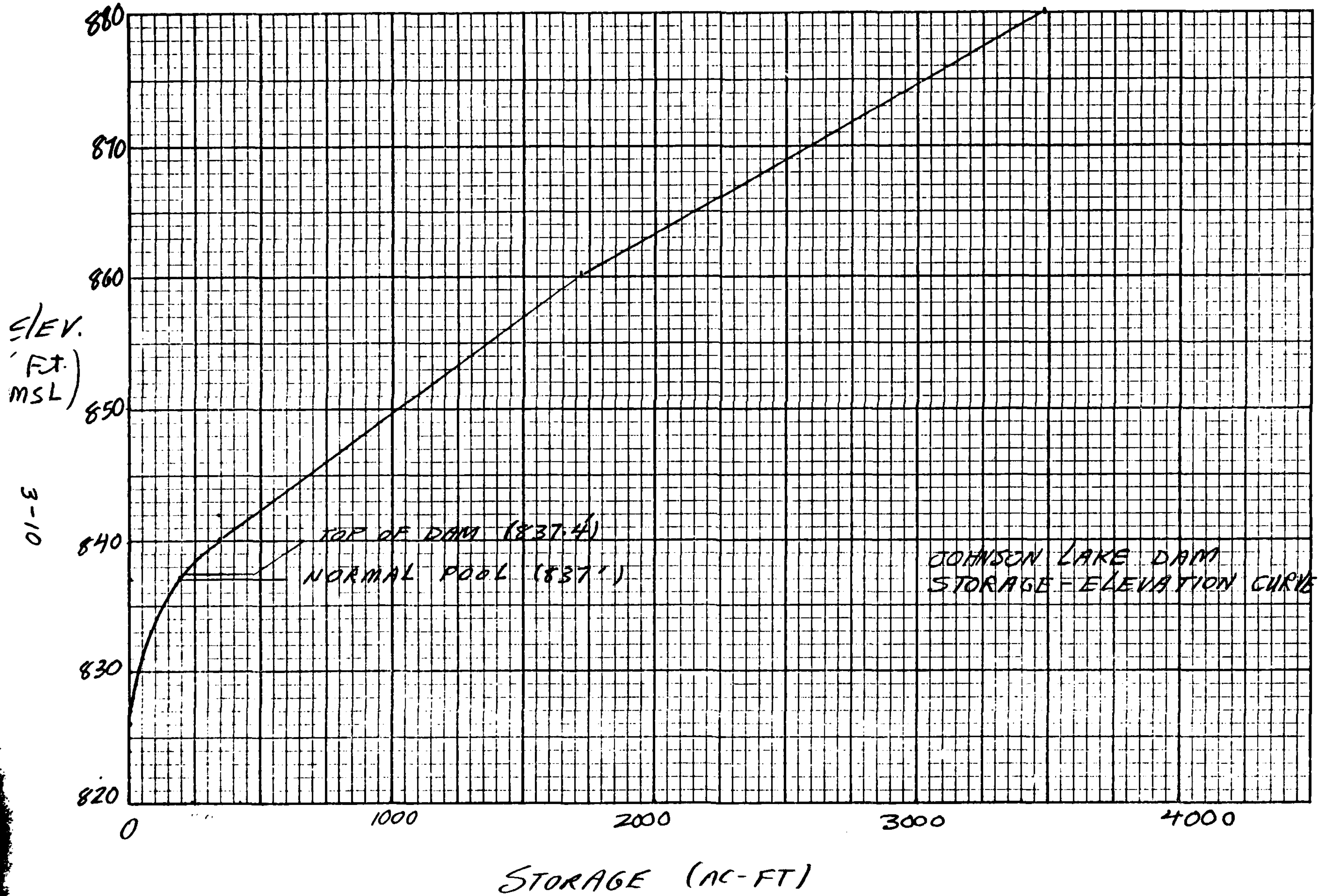
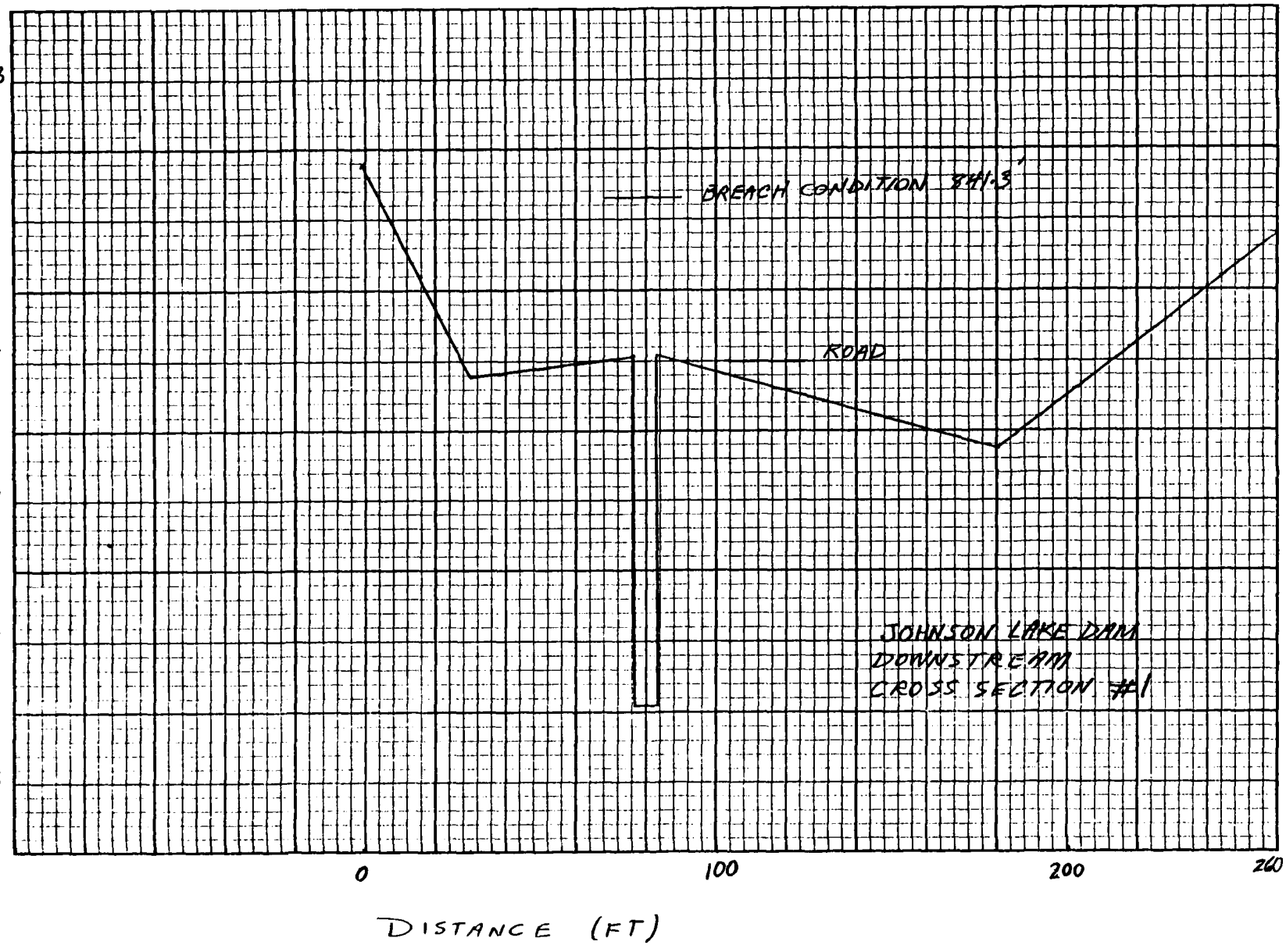
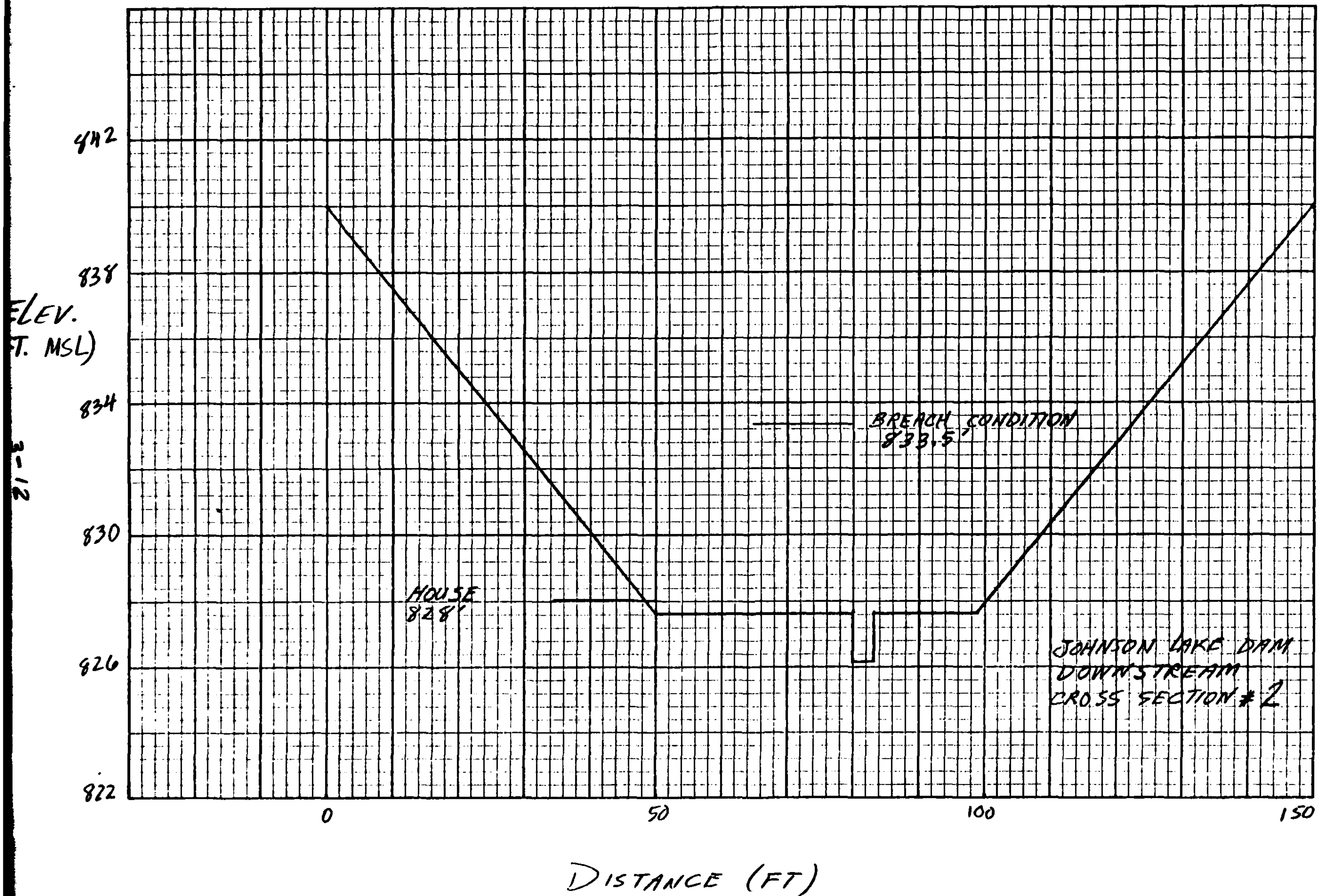
CHKD: ?DD





3-11

CONCEPTUAL ONLY
NOT FOR CONSTRUCTION



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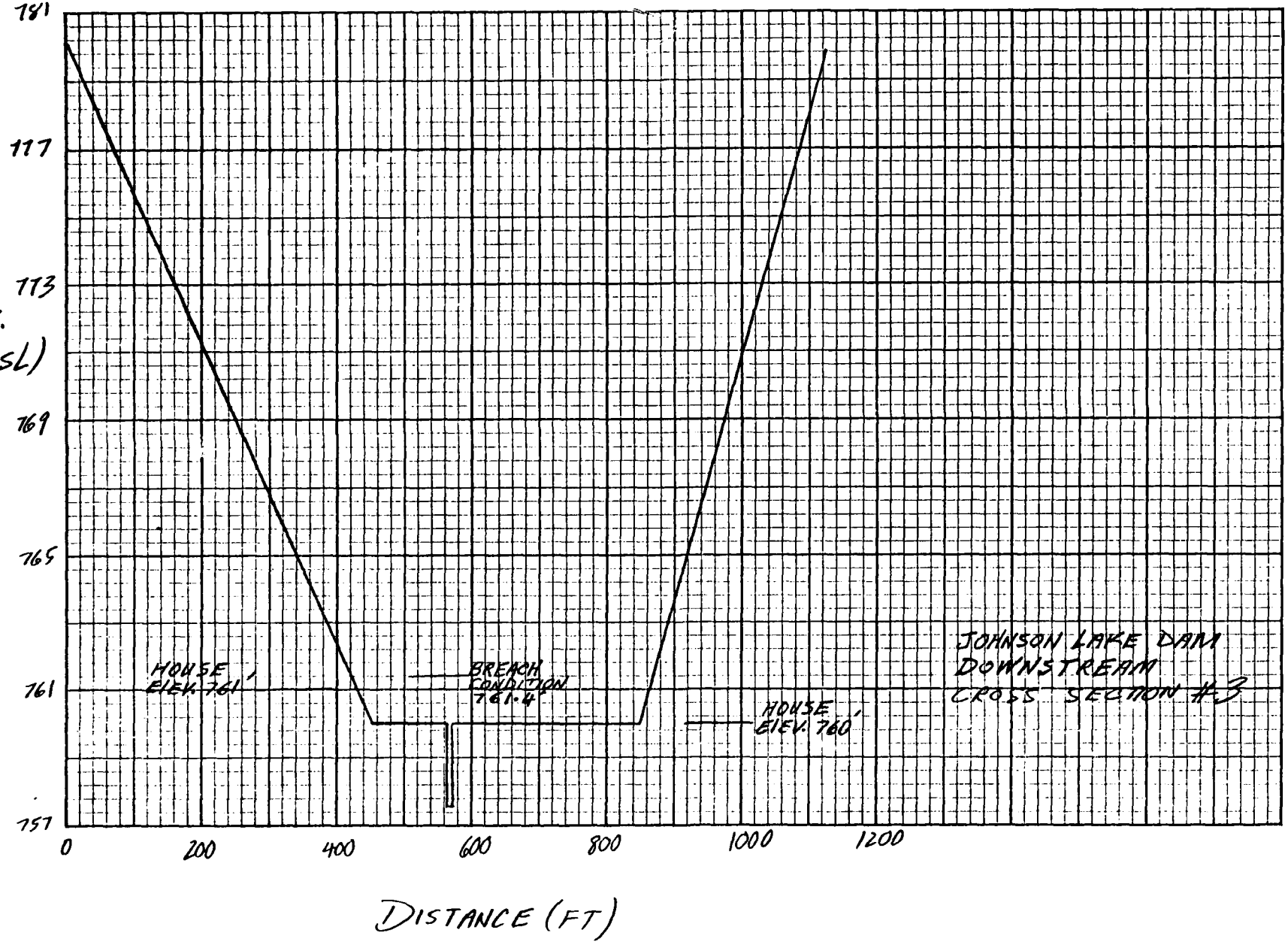

3-13

CONTOUR INTERVAL 200

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Subject JOHNSON LAKE DAM

JOB NO. 3409-14

Sheet No. _____ of _____
Date 11-27-79
Computed AWM
Checked FDD

DETERMINATION OF "C" FOR LOW LEVEL OUTLET

D = DIAMETER = 24" = 2 FT

n = 0.014 (OPEN CHANNEL HYDRAULICS, CHOW P. 110)

A_p = AREA OF PIPE OPENNING = 3.14 FT^2

L_p = LENGTH OF PIPE = 20 FT

K_f = FRICTION LOSS THROUGH PIPE

* K_e = ENTRANCE LOSS OF PIPE = 0.78

C_p = COEFFICIENT OF DISCHARGE (INCORPORATING A_p & $2g$)

C = COEFFICIENT OF DISCHARGE

$$K_f = \frac{5087\, n^2}{D^{4/3}}$$

$$C_p = A_p \sqrt{\frac{2g}{1 + K_e + K_f L_p}}$$

$$C = \frac{C_p / A_p}{\sqrt{2g}}$$

$$K_f = \frac{5087\,(0.014)^2}{(24)^{4/3}} = \frac{0.997}{68.5} = 0.014$$

$$C_p = 3.14 \sqrt{\frac{64.4}{1 + 0.78 + (0.014)(20)}} = 17.5$$

$$C = \frac{17.5/3.14}{\sqrt{64.4}} = 0.69$$

Anderson-Nichols & Company, Inc.

JOB NO. 3409-14

Subject JOHNSON LAKE DAM

Sheet No. _____ of _____

Date 11-27-79

Computed RANAA

Checked FDD

SQUARES 1/4 IN SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

DRAWDOWN CALCULATIONS

CALCULATIONS ASSUME:

1- NO SIGNIFICANT INFLOW
2- LOW LEVEL OUTLET TO BE OPERATING
3- INVERT U/S SAME AS INVERT AT LOW LEVEL OUTLET = 826'
4- $Q_p = C_p H^{1/2} = 17.5 H^{1/2}$ (SEE PREVIOUS PAGE)
5- AC-FT-DAY = 1.9835 (AVG. Q)
6- DAYS = Δ STORAGE / AC-FT-DAY

ELEV. FT	STORAGE AC-FT	ΔSTORAGE AC-FT	H FT	Q CFS	AVG. Q CFS	AC-FT PER DAY	DAYS
837	198		11	58			
		68			55	109	0.62
835	130		9	52.5			
		50			49.4	98	0.51
833	80		7	46.3			
		30			42.6	84.5	0.35
831	50		5	3.9			
		25			34.6	69	0.36
829	25		3	30.3			
		15			24	48	0.31
827	10		1	17.5			
		10			8.7	17	0.59
826	0		0	0			

2.74 DAYS

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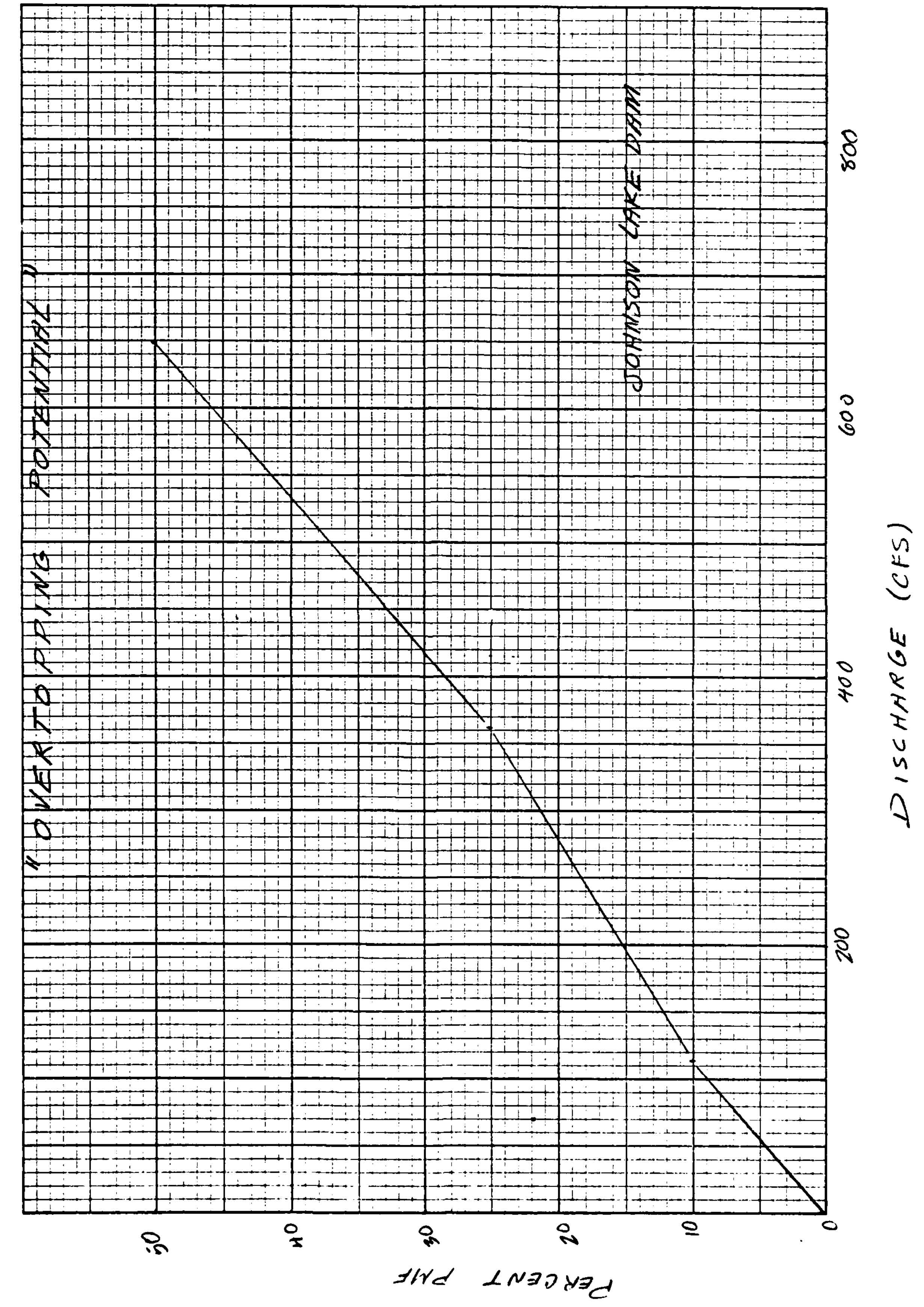
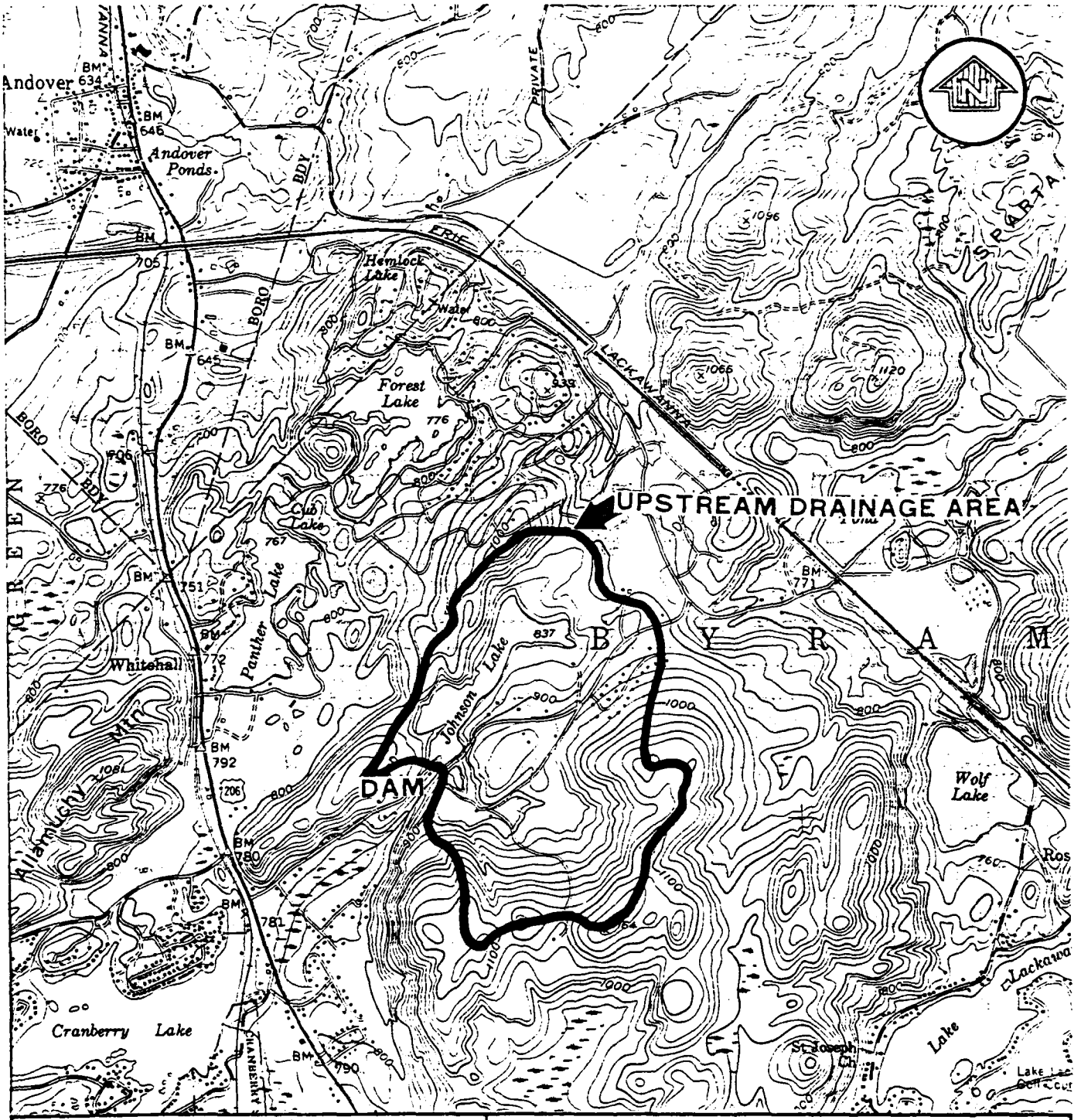
CHKD: FDD





NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

JOHNSON LAKE DAM

LOCKWOOD, NEW JERSEY

REGIONAL VICINITY MAP

JANUARY 1980

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

ANDERSON-NICHOLS & CO., INC. CONCORD, N.H.

SCALE IN MILES

0 1/2 1

MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE SHEET. STANHOPE, N.J. 1954. REVISED 1970.

HEC-1 OUTPUT

OVERTOPPING AND BREACH ANALYSIS

JOHNSON LAKE DAM

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1                 A1JOHNSON LAKE DAM OVERTOPPING ANALYSIS P. MIREMADI ANDERSON-NICHOLS
    2                 A2 DAM NUMBER US 00499
    3                 A30.1 0.25 0.50 MULTIPLES OF 24-HOUR PMP
    4                 P    170       0      10       0       0       0       0       0       0       0
    5                 P1     5
    6                 J      2       3       1
    7                 J1   0.1    0.25     0.5
    8                 K      0      A1                                              1
    9                 K1DEVELOP INFLOW HYDROGRAPH
   10                 P      1       2     0.6                       0.8                     1
   11                 P             22     111     123     133
   12                 T                                                       1     0.1
   13                 V2           0.58
   14                 Y     -3
   15                 K      1      A2                                              1
   16                 K1ROUTE INFLOW HYDROGRAPH THROUGH RESERVOIR
   17                 Y                             1       1
   18                 Y1     1                                          198      -1
   19                 Y4 836.7     837   837.4   838.1   838.7   839.5   841.2
   20                 Y5     0     2.3      28     146     357     808    3131
   21                 YS     0     170     198     215     240     270     375     425
   22                 YE 825.7   836.7     837   837.4   838.1   838.7   839.5   841.2
   23                 YS   837
   24                 SD 837.4
   25                 SB    11       1     826       1     837   837.4
   26                 SB    11       1     826       1     837     860
   27                 K      1
   28                 K1ROUTE OUTFLOW HYDROGRAPH THROUGH REACH ONE
   29                 Y                             1       1
   30                 Y1     1                                          -1
   31                 Y6   0.1    0.04     0.1   833.1   841.8     100   0.013
   32                 Y7     0   841.8      30   838.8      77   839.1      77   833.1      83   833.1
   33                 Y7    83   839.1     180   837.8     260   840.8
   34                 K      1
   35                 K1ROUTE OUTFLOW HYDROGRAPH THROUGH REACH TWO
   36                 Y                             1       1
   37                 Y1     1                                          -1
   38                 Y6   0.1    0.04     0.1   826.1     840     325   0.013
   39                 Y7     0     840      50   827.6      80   827.6      80   826.1      83   826.1
   40                 Y7    83   827.6      98   827.6     150     840
   41                 K      1
   42                 K1ROUTE OUTFLOW HYDROGRAPH THROUGH REACH THREE
   43                 Y                             1       1
   44                 Y1     1                                          -1
   45                 Y6   0.1    0.04     0.1   757.5     780    2800   0.023
   46                 Y7     0     780     450     760     550     760     550   757.5   552.5   757.5
   47                 Y7 552.5     760   822.5     760    1120     780
   48                 K     99


                   PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                            RUNOFF HYDROGRAPH AT          A1
                            ROUTE HYDROGRAPH TO           A2
                            ROUTE HYDROGRAPH TO
                            ROUTE HYDROGRAPH TO
                            ROUTE HYDROGRAPH TO
                            END OF NETWORK
```

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 79/11/21.
     TIME= 08.02.19.
```

JOHNSON LAKE DAM OVERTOPPING ANALYSIS M. MIREMADI ANDERSON-NICHOLS
DAM NUMBER US 00499
0.1 0.25 0.50 MULTIPLES OF 24-HOUR PMP

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
170	0	10	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 3 LRTIO= 1

RTIOS= .10 .25 .50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

DEVELOP INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.60	0.00	.60	.80	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	111.00	123.00	133.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .58

RECESSION DATA
STRTQ= -3.00 QRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 19 END OF PERIOD ORDINATES. TC= 0.00 HOURS. LAG= .58 VOL= 1.00

64.	208.	385.	477.	390.	294.	183.	121.	83.	54.
36.	24.	16.	11.	7.	5.	3.	2.	1.	

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.02	0.00	.02	2.
1.01	.20	2	.02	0.00	.02	2.
1.01	.30	3	.02	0.00	.02	2.
1.01	.40	4	.02	0.00	.02	2.
1.01	.50	5	.02	0.00	.02	2.
1.01	1.00	6	.02	0.00	.02	2.
1.01	1.10	7	.02	0.00	.02	2.
1.01	1.20	8	.02	0.00	.02	2.
1.01	1.30	9	.02	0.00	.02	2.
1.01	1.40	10	.02	0.00	.02	2.
1.01	1.50	11	.02	0.00	.02	2.
1.01	2.00	12	.02	0.00	.02	2.
1.01	2.10	13	.02	0.00	.02	2.
1.01	2.20	14	.02	0.00	.02	2.
1.01	2.30	15	.02	0.00	.02	2.
1.01	2.40	16	.02	0.00	.02	2.
1.01	2.50	17	.02	0.00	.02	2.
1.01	3.00	18	.02	0.00	.02	2.
1.01	3.10	19	.02	0.00	.02	2.
1.01	3.20	20	.02	0.00	.02	2.
1.01	3.30	21	.02	0.00	.02	2.
1.01	3.40	22	.02	0.00	.02	2.
1.01	3.50	23	.02	0.00	.02	2.
1.01	4.00	24	.02	0.00	.02	2.
1.01	4.10	25	.02	0.00	.02	2.
1.01	4.20	26	.02	0.00	.02	2.
1.01	4.30	27	.02	0.00	.02	2.
1.01	4.40	28	.02	0.00	.02	2.
1.01	4.50	29	.02	0.00	.02	2.
1.01	5.00	30	.02	0.00	.02	2.
1.01	5.10	31	.02	0.00	.02	2.
1.01	5.20	32	.02	0.00	.02	2.
1.01	5.30	33	.02	0.00	.02	2.
1.01	5.40	34	.02	0.00	.02	2.
1.01	5.50	35	.02	0.00	.02	2.
1.01	6.00	36	.02	0.00	.02	2.
1.01	6.10	37	.06	0.00	.06	2.
1.01	6.20	38	.06	0.00	.06	2.
1.01	6.30	39	.06	0.00	.06	2.
1.01	6.40	40	.06	0.00	.06	2.
1.01	6.50	41	.06	0.00	.06	2.
1.01	7.00	42	.06	.04	.02	4.
1.01	7.10	43	.06	.04	.02	13.
1.01	7.20	44	.06	.04	.02	29.
1.01	7.30	45	.06	.04	.02	47.
1.01	7.40	46	.06	.04	.02	63.
1.01	7.50	47	.06	.04	.02	76.
1.01	8.00	48	.06	.04	.02	84.
1.01	8.10	49	.06	.04	.02	89.
1.01	8.20	50	.06	.04	.02	92.
1.01	8.30	51	.06	.04	.02	95.
1.01	8.40	52	.06	.04	.02	96.
1.01	8.50	53	.06	.04	.02	97.
1.01	9.00	54	.06	.04	.02	98.
1.01	9.10	55	.06	.04	.02	99.
1.01	9.20	56	.06	.04	.02	99.
1.01	9.30	57	.06	.04	.02	99.
1.01	9.40	58	.06	.04	.02	99.
1.01	14.20	86	.49	.47	.02	876.
1.01	14.30	87	.49	.47	.02	921.
1.01	14.40	88	.49	.47	.02	969.
1.01	14.50	89	.49	.47	.02	1010.
1.01	15.00	90	.49	.47	.02	1041.
1.01	15.10	91	.45	.43	.02	1057.
1.01	15.20	92	.74	.73	.02	1080.
1.01	15.30	93	1.34	1.32	.02	1171.
1.01	15.40	94	3.34	3.32	.02	1524.
1.01	15.50	95	.97	.95	.02	2134.
1.01	16.00	96	.59	.58	.02	2753.
1.01	16.10	97	.46	.44	.02	2942.
1.01	16.20	98	.46	.44	.02	2737.
1.01	16.30	99	.46	.44	.02	2326.
1.01	16.40	100	.46	.44	.02	1886.
1.01	16.50	101	.46	.44	.02	1594.
1.01	17.00	102	.46	.44	.02	1406.
1.01	17.10	103	.36	.34	.02	1270.
1.01	17.20	104	.36	.34	.02	1164.
1.01	17.30	105	.36	.34	.02	1069.
1.01	17.40	106	.36	.34	.02	989.
1.01	17.50	107	.36	.34	.02	926.
1.01	18.00	108	.36	.34	.02	881.
1.01	18.10	109	.03	.01	.02	831.
1.01	18.20	110	.03	.01	.02	744.
1.01	18.30	111	.03	.01	.02	604.
1.01	18.40	112	.03	.01	.02	450.
1.01	18.50	113	.03	.01	.02	315.
1.01	19.00	114	.03	.01	.02	215.
1.01	19.10	115	.03	.01	.02	153.
1.01	19.20	116	.03	.01	.02	112.
1.01	19.30	117	.03	.01	.02	85.
1.01	19.40	118	.03	.01	.02	66.
1.01	19.50	119	.03	.01	.02	54.
1.01	20.00	120	.03	.01	.02	46.
1.01	20.10	121	.03	.01	.02	41.
1.01	20.20	122	.03	.01	.02	37.
1.01	20.30	123	.03	.01	.02	35.
1.01	20.40	124	.03	.01	.02	33.
1.01	20.50	125	.03	.01	.02	32.
1.01	21.00	126	.03	.01	.02	32.
1.01	21.10	127	.03	.01	.02	31.
1.01	21.20	128	.03	.01	.02	31.
1.01	21.30	129	.03	.01	.02	31.
1.01	21.40	130	.03	.01	.02	31.
1.01	21.50	131	.03	.01	.02	31.
1.01	22.00	132	.03	.01	.02	31.
1.01	22.10	133	.03	.01	.02	31.
1.01	22.20	134	.03	.01	.02	31.
1.01	22.30	135	.03	.01	.02	31.
1.01	22.40	136	.03	.01	.02	31.
1.01	22.50	137	.03	.01	.02	31.
1.01	23.00	138	.03	.01	.02	31.
1.01	23.10	139	.03	.01	.02	31.
1.01	23.20	140	.03	.01	.02	31.
1.01	23.30	141	.03	.01	.02	31.
1.01	23.40	142	.03	.01	.02	31.
1.01	23.50	143	.03	.01	.02	31.

1.01	9.50	59	.06	.04	.02	99.	1.02	0.00	144	.03	.01	.02	31.
1.01	10.00	60	.06	.04	.02	99.	1.02	.10	145	0.00	0.00	0.00	30.
1.01	10.10	61	.06	.04	.02	99.	1.02	.20	146	0.00	0.00	0.00	28.
1.01	10.20	62	.06	.04	.02	99.	1.02	.30	147	0.00	0.00	0.00	23.
1.01	10.30	63	.06	.04	.02	99.	1.02	.40	148	0.00	0.00	0.00	17.
1.01	10.40	64	.06	.04	.02	99.	1.02	.50	149	0.00	0.00	0.00	12.
1.01	10.50	65	.06	.04	.02	99.	1.02	1.00	150	0.00	0.00	0.00	9.
1.01	11.00	66	.06	.04	.02	99.	1.02	1.10	151	0.00	0.00	0.00	6.
1.01	11.10	67	.06	.04	.02	99.	1.02	1.20	152	0.00	0.00	0.00	5.
1.01	11.20	68	.06	.04	.02	99.	1.02	1.30	153	0.00	0.00	0.00	4.
1.01	11.30	69	.06	.04	.02	99.	1.02	1.40	154	0.00	0.00	0.00	3.
1.01	11.40	70	.06	.04	.02	99.	1.02	1.50	155	0.00	0.00	0.00	3.
1.01	11.50	71	.06	.04	.02	99.	1.02	2.00	156	0.00	0.00	0.00	2.
1.01	12.00	72	.06	.04	.02	99.	1.02	2.10	157	0.00	0.00	0.00	2.
1.01	12.10	73	.33	.31	.02	116.	1.02	2.20	158	0.00	0.00	0.00	2.
1.01	12.20	74	.33	.31	.02	172.	1.02	2.30	159	0.00	0.00	0.00	2.
1.01	12.30	75	.33	.31	.02	274.	1.02	2.40	160	0.00	0.00	0.00	2.
1.01	12.40	76	.33	.31	.02	391.	1.02	2.50	161	0.00	0.00	0.00	2.
1.01	12.50	77	.33	.31	.02	495.	1.02	3.00	162	0.00	0.00	0.00	2.
1.01	13.00	78	.33	.31	.02	574.	1.02	3.10	163	0.00	0.00	0.00	2.
1.01	13.10	79	.39	.37	.02	627.	1.02	3.20	164	0.00	0.00	0.00	2.
1.01	13.20	80	.39	.37	.02	672.	1.02	3.30	165	0.00	0.00	0.00	2.
1.01	13.30	81	.39	.37	.02	719.	1.02	3.40	166	0.00	0.00	0.00	2.
1.01	13.40	82	.39	.37	.02	763.	1.02	3.50	167	0.00	0.00	0.00	2.
1.01	13.50	83	.39	.37	.02	798.	1.02	4.00	168	0.00	0.00	0.00	2.
1.01	14.00	84	.39	.37	.02	823.	1.02	4.10	169	0.00	0.00	0.00	2.
1.01	14.10	85	.49	.47	.02	845.	1.02	4.20	170	0.00	0.00	0.00	2.
									SUM	23.41	20.69	2.72	48355.
										(595.)	(526.)	(69.)	(1369.26)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2942.	1184.	335.	284.	48351.
CMS	83.	34.	9.	8.	1369.
INCHES		18.36	20.80	20.82	20.82
MM		466.43	528.41	528.91	528.91
AC-FT		587.	665.	666.	666.
THOUS CU M		724.	821.	821.	821.

HYDROGRAPH AT STA A1 FOR PLAN 1, RTIO 3 (BREACH)

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	2.	6.	14.	23.	32.	38.	42.	44.	46.
47.	48.	49.	49.	49.	49.	50.	50.	50.	50.
50.	50.	50.	50.	50.	50.	50.	50.	50.	50.
50.	50.	50.	86.	137.	196.	248.	287.	313.	336.
360.	381.	399.	411.	423.	438.	461.	484.	505.	520.
529.	540.	586.	762.	1067.	1376.	1471.	1369.	1163.	943.
797.	703.	635.	582.	534.	495.	463.	440.	416.	372.
302.	225.	157.	108.	77.	56.	42.	33.	27.	23.
20.	19.	17.	17.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	15.	14.	11.	9.	6.	4.
3.	2.	2.	2.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1471.	592.	168.	142.	24176.

CMS	42.	17.	5.	4.	685.
INCHES		9.10	10.40	10.41	10.41
MM		233.22	264.21	264.45	264.45
AC-FT		294.	332.	333.	333.
THOUS CU M		362.	410.	411.	411.

PLAN 2 SAME AS PLAN 1

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HYDROGRAPH ROUTING

ROUTE INFLOW HYDROGRAPH THROUGH RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	198.	-1

STAGE	836.70	837.00	837.40	838.10	838.70	839.50	841.20
FLOW	0.00	2.30	28.00	146.00	357.00	808.00	3131.00
CAPACITY=	0.	170.	198.	215.	240.	270.	375.	425.
ELEVATION=	826.	837.	837.	837.	838.	839.	840.	841.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
837.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	CCOD	EXPD	DAMWID
837.4	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBR	TFAIL	WSEL	FAILEL
11.	1.00	826.00	1.00	837.00	837.40

CVN

STATION A2, PLAN 1, RATIO 3 (BREACH)

BEGIN DAM FAILURE AT 12.67 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	3.	3.	4.	5.	6.	6.	6.
7.	8.	9.	10.	10.	11.	12.	13.	14.	14.
15.	16.	16.	17.	18.	18.	19.	20.	20.	21.
21.	22.	23.	24.	26.	29.	145.	370.	(676.)	1066.
1529.	(2118.)	1708.	1382.	1162.	1007.	896.	815.	757.	714.
681.	656.	641.	646.	692.	785.	906.	1008.	1062.	1060.
1020.	965.	907.	850.	795.	745.	698.	656.	618.	582.
544.	502.	457.	412.	369.	331.	298.	268.	242.	219.
199.	182.	167.	153.	142.	131.	122.	113.	106.	99.
93.	88.	83.	78.	74.	70.	67.	64.	61.	58.
56.	53.	51.	49.	47.	45.	44.	42.	40.	38.
37.	35.	33.	32.	30.	29.	28.	27.	26.	24.
23.	23.	22.	21.	20.	19.	19.	18.	17.	17.

STORAGE

198.	198.	198.	198.	198.	198.	198.	198.	198.	198.
198.	198.	198.	198.	198.	198.	198.	198.	198.	198.
198.	198.	198.	198.	198.	198.	198.	198.	198.	198.
198.	198.	198.	198.	198.	198.	198.	198.	198.	198.
198.	198.	198.	198.	198.	199.	199.	200.	200.	201.
201.	202.	202.	203.	203.	204.	204.	205.	205.	206.
206.	207.	207.	208.	208.	209.	209.	209.	210.	210.
211.	211.	212.	212.	213.	215.	217.	217.	(215.)	207.
194.	174.	153.	137.	126.	117.	110.	104.	100.	97.
95.	93.	92.	92.	96.	102.	110.	117.	120.	120.
118.	114.	110.	107.	103.	100.	96.	93.	90.	87.
84.	81.	77.	73.	69.	65.	61.	58.	54.	52.
49.	47.	45.	43.	41.	39.	38.	36.	35.	34.
33.	32.	31.	30.	29.	28.	27.	27.	26.	25.
25.	24.	24.	23.	23.	22.	22.	22.	21.	21.
20.	20.	19.	19.	18.	18.	18.	17.	17.	17.
16.	16.	16.	15.	15.	15.	15.	14.	14.	14.

STAGE

837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.1
837.1	837.1	837.1	837.1	837.1	837.1	837.2	837.2	837.2	837.2
837.2	837.2	837.2	837.2	837.2	837.3	837.3	837.3	837.3	837.3
837.3	837.3	837.3	837.3	837.4	837.4	837.5	837.5	(837.4)	837.2
837.0	836.7	836.6	836.6	833.8	833.3	832.8	832.5	832.2	832.0
831.8	831.7	831.7	831.7	831.9	832.3	832.8	833.3	833.5	833.5
833.3	833.1	832.8	832.6	832.4	832.1	831.9	831.7	831.5	831.4
831.2	830.9	830.7	830.4	830.1	829.9	829.6	829.4	829.2	829.0
828.9	828.7	828.6	828.5	828.3	828.2	828.1	828.0	828.0	827.9

827.8	827.7	827.7	827.6	827.6	827.5	827.5	827.4	827.4	827.3
827.3	827.3	827.2	827.2	827.2	827.2	827.1	827.1	827.1	827.0
827.0	827.0	826.9	826.9	826.9	826.9	826.8	826.8	826.8	826.8
826.8	826.7	826.7	826.7	826.7	826.7	826.6	826.6	826.6	826.6

PEAK OUTFLOW IS 2118. AT TIME 13.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2118.	889.	261.	221.	37626.
CMS	60.	25.	7.	6.	1065.
INCHES		13.65	16.18	16.20	16.20
MM		346.72	410.95	411.58	411.58
AC-FT		437.	517.	518.	518.
THOUS CU M		539.	638.	639.	639.

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

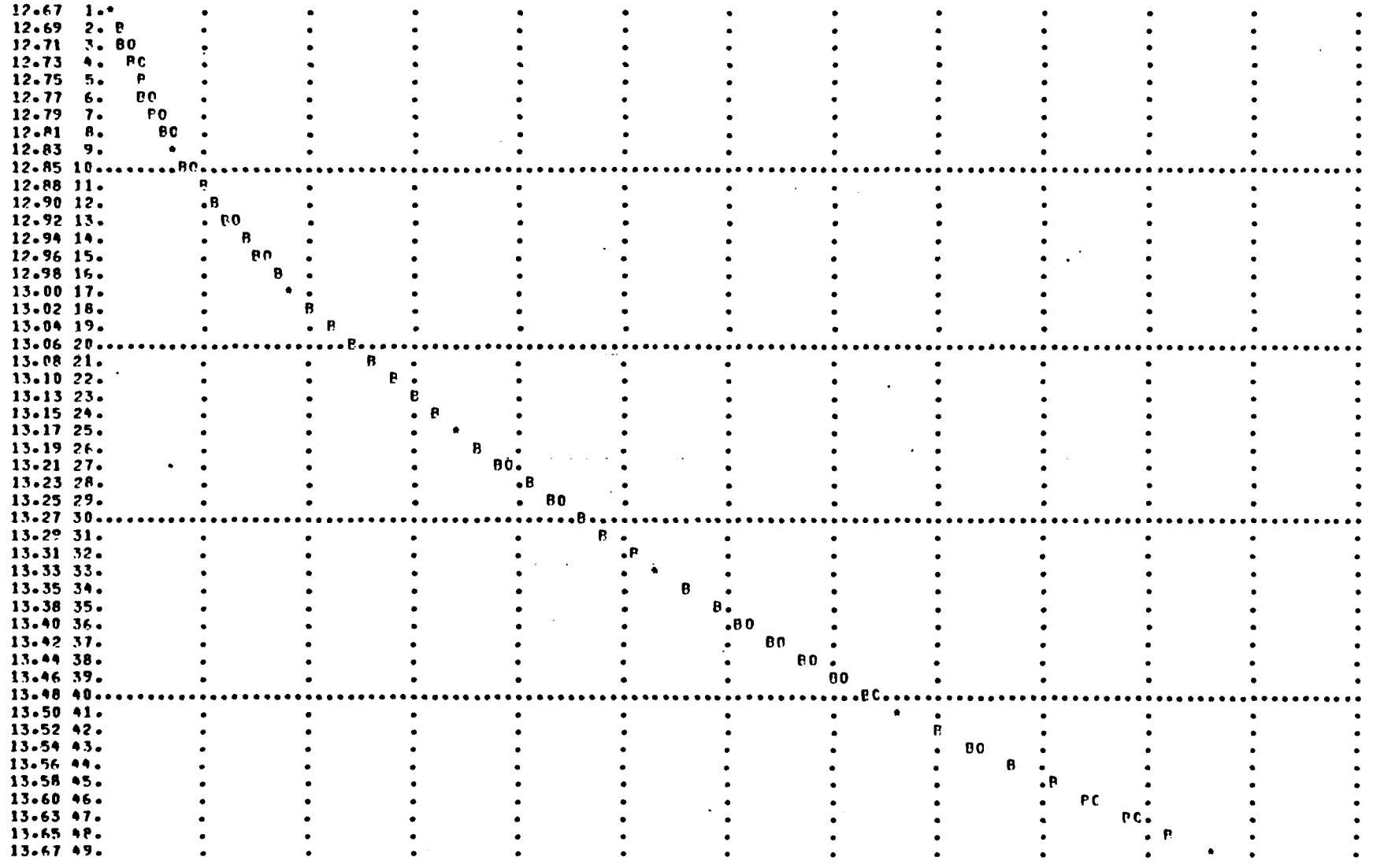
TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	-	COMPUTED BREACH HYDROGRAPH (CFS)	=	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
12.667	0.000	29.		29.		0.	0.	0.
12.688	.021	44.		35.		9.	9.	0.
12.708	.042	58.		44.		14.	23.	0.
12.729	.063	73.		56.		17.	39.	0.
12.750	.083	87.		70.		17.	56.	0.
12.771	.104	102.		86.		15.	72.	0.
12.792	.125	116.		104.		12.	84.	0.
12.813	.146	131.		124.		7.	91.	0.
12.833	.167	145.		145.		0.	91.	0.
12.854	.188	173.		168.		5.	96.	0.
12.875	.208	201.		193.		9.	104.	0.
12.896	.229	229.		219.		11.	115.	0.
12.917	.250	257.		246.		11.	126.	0.
12.938	.271	285.		275.		11.	137.	0.
12.958	.292	313.		305.		8.	145.	0.
12.979	.313	342.		337.		5.	150.	0.
13.000	.333	370.		370.		0.	150.	0.
13.021	.354	408.		404.		4.	154.	0.
13.042	.375	446.		439.		7.	161.	0.
13.063	.396	484.		476.		9.	170.	0.
13.083	.417	523.		513.		9.	179.	0.
13.104	.438	561.		552.		9.	188.	0.
13.125	.458	599.		592.		8.	196.	0.
13.146	.479	637.		632.		5.	201.	0.
13.167	.500	676.		676.		0.	201.	0.
13.188	.521	724.		721.		4.	205.	0.
13.208	.542	773.		767.		6.	211.	0.
13.229	.563	822.		814.		8.	219.	0.
13.250	.583	871.		863.		8.	227.	0.
13.271	.604	919.		912.		7.	234.	0.
13.292	.625	968.		962.		6.	240.	0.
13.313	.646	1017.		1013.		3.	243.	0.
13.333	.667	1066.		1066.		0.	243.	0.
13.354	.688	1124.		1119.		5.	248.	0.
13.375	.708	1181.		1172.		9.	257.	0.
13.396	.729	1239.		1227.		12.	270.	0.
13.417	.750	1297.		1282.		15.	285.	0.
13.438	.771	1355.		1338.		17.	302.	1.
13.458	.792	1413.		1395.		18.	320.	1.
13.479	.812	1471.		1461.		10.	331.	1.
13.500	.833	1529.		1529.		0.	331.	1.
13.521	.854	1603.		1599.		4.	335.	1.
13.542	.875	1676.		1669.		7.	342.	1.
13.563	.896	1750.		1741.		9.	351.	1.
13.583	.917	1823.		1814.		9.	360.	1.
13.604	.937	1897.		1888.		9.	369.	1.
13.625	.958	1971.		1964.		7.	376.	1.
13.646	.979	2044.		2040.		4.	380.	1.
13.667	1.000	2118.		2118.		0.	380.	1.

CVF

STATION A2

TIME (HRS)

(O) INTERPOLATED BREACH HYDROGRAPH
(B) COMPUTED BREACH HYDROGRAPH
(*) POINTS AT NORMAL TIME INTERVAL



END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	3.	3.	3.	4.	5.	6.	6.
7.	8.	9.	10.	10.	11.	12.	13.	14.	14.
15.	16.	16.	17.	18.	18.	19.	20.	20.	21.
21.	22.	23.	24.	26.	29.	41.	56.	71.	87.
103.	120.	137.	158.	182.	205.	227.	250.	273.	295.
316.	336.	357.	375.	406.	453.	509.	561.	602.	628.
641.	(648.)	648.	645.	640.	633.	624.	614.	604.	592.
577.	559.	538.	514.	490.	466.	442.	419.	396.	375.
353.	322.	294.	269.	245.	224.	205.	187.	171.	157.
145.	137.	129.	122.	115.	109.	103.	97.	92.	87.
83.	79.	75.	72.	68.	65.	62.	59.	55.	52.
49.	46.	44.	41.	39.	36.	34.	32.	30.	28.
28.	27.	26.	26.	25.	25.	24.	24.	23.	23.

STORAGE

198.	198.	198.	198.	198.	198.	198.	198.	198.	198.
198.	198.	198.	198.	198.	198.	198.	198.	198.	198.

198.	198.	198.	198.	198.	198.	198.	198.	198.	198.
198.	198.	198.	198.	198.	198.	198.	198.	198.	198.
198.	198.	198.	198.	198.	199.	199.	200.	200.	201.
201.	202.	202.	203.	203.	204.	204.	205.	205.	206.
206.	207.	207.	208.	208.	209.	209.	209.	210.	210.
211.	211.	211.	212.	213.	215.	218.	221.	224.	228.
231.	235.	238.	242.	245.	248.	252.	255.	258.	261.
264.	267.	270.	274.	281.	292.	305.	318.	327.	333.
336.	338.	338.	337.	336.	334.	332.	330.	327.	325.
321.	317.	312.	307.	301.	295.	290.	284.	279.	274.
269.	265.	261.	257.	254.	251.	248.	246.	244.	242.
240.	238.	236.	235.	233.	232.	231.	230.	229.	228.
227.	226.	225.	224.	224.	223.	222.	221.	221.	220.
220.	219.	218.	218.	217.	217.	216.	216.	215.	215.
215.	214.	214.	214.	213.	213.	213.	212.	212.	212.

STAGE

837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0
837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.0	837.1
837.1	837.1	837.1	837.1	837.1	837.1	837.2	837.2	837.2	837.2
837.2	837.2	837.2	837.2	837.2	837.3	837.3	837.3	837.3	837.3
837.3	837.3	837.3	837.3	837.4	837.4	837.5	837.6	837.7	837.8
837.8	837.9	838.0	838.1	838.2	838.3	838.3	838.4	838.5	838.5
838.6	838.6	838.7	838.7	838.8	838.9	839.0	839.1	839.1	839.2
839.2	839.2	839.2	839.2	839.2	839.2	839.2	839.2	839.1	839.1
839.1	839.1	839.0	839.0	838.9	838.9	838.9	838.8	838.8	838.7
838.7	838.6	838.5	838.4	838.4	838.3	838.3	838.2	838.2	838.1
838.1	838.0	838.0	838.0	837.9	837.9	837.8	837.8	837.8	837.8
837.7	837.7	837.7	837.7	837.6	837.6	837.6	837.6	837.6	837.5
837.5	837.5	837.5	837.5	837.5	837.4	837.4	837.4	837.4	837.4
837.4	837.4	837.4	837.4	837.4	837.4	837.3	837.3	837.3	837.3

PEAK OUTFLOW IS 648. AT TIME 17.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	648.	483.	161.	137.	23229.
CMS	18.	14.	5.	4.	658.
INCHES		7.50	9.98	10.00	10.00
MM		190.39	253.47	254.10	254.10
AC-FT		240.	319.	320.	320.
THOUS CU M		296.	394.	395.	395.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE OUTFLOW HYDROGRAPH THROUGH REACH ONE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	1	0	0	0	0	0	0	0

ALL PLANS HAVE SAME

ROUTING DATA

CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

MAXIMUM STAGE IS 841.2

STATION 1 , PLAN 1, RTIO 3 (BREACH)

OUTFLOW

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	3.	4.	5.	5.	6.
7.	8.	9.	10.	10.	11.	12.	13.	14.	14.
15.	16.	16.	17.	18.	18.	19.	20.	20.	21.
21.	22.	23.	24.	25.	29.	140.	342.	660.	1041.
1512.	2093.	1757.	1365.	1193.	994.	916.	806.	770.	708.
699.	652.	646.	642.	690.	777.	901.	1003.	1062.	1060.
1024.	968.	910.	852.	799.	747.	701.	658.	621.	584.
546.	505.	460.	415.	372.	334.	301.	270.	244.	221.
201.	182.	168.	153.	142.	131.	122.	113.	106.	99.
94.	88.	83.	78.	74.	70.	67.	64.	61.	58.
56.	53.	51.	49.	47.	45.	44.	42.	40.	38.
37.	35.	33.	32.	31.	29.	28.	27.	26.	25.
24.	23.	22.	21.	20.	19.	19.	18.	17.	17.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3
833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3
833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3
833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3
833.3	833.3	833.3	833.3	833.3	833.3	833.4	833.4	833.5	833.6
833.6	833.6	833.7	833.7	833.7	833.7	833.8	833.8	833.8	833.9
833.9	833.9	833.9	834.0	834.0	834.0	834.0	834.1	834.1	834.1
834.1	834.1	834.1	834.2	834.2	834.3	837.0	839.1	839.7	840.2
840.8	841.3	841.0	840.6	840.4	840.2	840.1	839.9	839.9	839.8
839.7	839.7	839.7	839.7	839.7	839.9	840.1	840.2	840.3	840.3
840.2	840.1	840.1	840.0	839.9	839.8	839.8	839.7	839.6	839.6
839.5	839.4	839.3	839.2	839.1	839.0	838.9	838.7	838.6	838.4
838.2	837.8	837.6	837.3	837.0	836.8	836.6	836.4	836.2	836.1
835.9	835.8	835.7	835.6	835.5	835.4	835.3	835.2	835.2	835.1
835.1	835.0	834.9	834.9	834.8	834.8	834.7	834.7	834.6	834.6
834.6	834.5	834.5	834.4	834.4	834.3	834.3	834.3	834.2	834.2
834.2	834.1	834.1	834.1	834.1	834.0	834.0	834.0	834.0	833.9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2093.	880.	261.	221.	37625.
CMS	59.	25.	7.	6.	1065.
INCHES		13.65	16.18	16.20	16.20
MM		346.66	410.95	411.58	411.58
AC-FT		437.	517.	518.	518.
THOUS CU M		538.	638.	639.	639.

MAXIMUM STORAGE = 1.

MAXIMUM STAGE IS 841.3

STATION 1 , PLAN 2, RTIO 3 (OVERTOPPING)

OUTFLOW

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	3.	4.	5.	5.	6.
7.	8.	9.	10.	10.	11.	12.	13.	13.	14.
15.	16.	16.	17.	19.	18.	19.	20.	20.	21.
21.	22.	23.	24.	25.	29.	41.	55.	71.	87.
103.	120.	137.	157.	181.	203.	225.	248.	270.	293.
314.	334.	355.	374.	403.	449.	504.	558.	600.	626.
641.	647.	648.	645.	641.	633.	625.	615.	604.	592.
578.	560.	539.	516.	492.	468.	444.	420.	396.	377.
359.	326.	297.	271.	247.	226.	207.	188.	172.	157.

[illegible]	[illegible]	129.	122.	116.	109.	103.	97.	93.	87.
[illegible]	[illegible]	75.	71.	68.	65.	62.	59.	56.	52.
[illegible]	46.	44.	41.	39.	36.	34.	32.	30.	28.
[illegible]	27.	26.	26.	25.	25.	24.	24.	23.	23.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3
833.3	833.3	833.3	833.3	833.3	833.3	83. 3	833.3	833.3	833.3
833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3
833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3	833.3
833.3	833.3	833.3	833.3	833.3	833.3	833.4	833.4	833.5	833.6
833.6	833.6	833.7	833.7	833.7	833.7	833.8	833.8	833.8	833.9
833.9	833.9	833.9	834.0	834.0	834.0	834.0	834.1	834.1	834.1
834.1	834.1	834.1	834.2	834.2	834.3	834.7	835.0	835.4	835.8
836.2	836.5	836.9	837.3	837.8	838.2	838.4	838.6	838.7	838.8
838.9	839.0	839.1	839.1	839.2	839.3	839.4	839.5	839.6	839.6
839.7	839.7	839.7	839.7	839.7	839.7	839.6	839.6	839.6	839.6
839.6	839.5	839.5	839.4	839.4	839.3	839.3	839.2	839.2	839.1
839.1	839.0	838.8	838.7	838.6	838.4	838.2	838.0	837.7	837.3
837.1	836.9	836.7	836.6	836.4	836.3	836.2	836.0	835.9	835.8
835.7	835.6	835.5	835.4	835.4	835.3	835.2	835.1	835.0	835.0
834.9	834.8	834.7	834.7	834.6	834.5	834.5	834.4	834.4	834.3
834.3	834.3	834.3	834.2	834.2	834.2	834.2	834.2	834.2	834.2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	648.	483.	161.	137.	23228.
CMS	18.	14.	5.	4.	658.
INCHES		7.49	9.98	10.00	10.00
MM		190.36	253.46	254.09	254.09
AC-FT		240.	319.	320.	320.
THOUS CU M		296.	394.	395.	395.

MAXIMUM STORAGE = 1.

MAXIMUM STAGE IS 839.7

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HYDROGRAPH ROUTING

ROUTE OUTFLOW HYDROGRAPH THROUGH REACH TWO

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	1	0	0	0	0	0	0	0

ALL PLANS HAVE SAME ROUTING DATA

OLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0400	.1000	826.1	840.0	325.	.01300

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 840.00 50.00 827.60 80.00 827.60 80.00 826.10 83.00 826.10
83.00 827.60 98.00 827.60 150.00 840.00

STORAGE	0.00	.02	.03	.30	.61	.95	1.32	1.73	2.17	2.65
	3.15	3.69	4.27	4.87	5.51	6.18	6.88	7.62	8.39	9.19
OUTFLOW	0.00	5.81	15.26	72.29	192.79	366.33	591.03	866.93	1194.93	1576.35
	2012.74	2505.79	3057.28	3669.00	4342.80	5080.53	5884.04	6755.17	7695.76	8707.65
STAGE	826.10	826.83	827.56	828.29	829.03	829.76	830.49	831.22	831.95	832.68
	833.42	834.15	834.88	835.61	836.34	837.07	837.81	838.54	839.27	840.00
FLOW	0.00	5.81	15.26	72.29	192.79	366.33	591.03	866.93	1194.93	1576.35
	2012.74	2505.79	3057.28	3669.00	4342.80	5080.53	5884.04	6755.17	7695.76	8707.65

MAXIMUM STAGE IS 833.4

STATION 2 , PLAN 1, RTIO 3 (BREACH)

OUTFLOW

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	3.	4.	5.	5.	6.
7.	8.	9.	9.	10.	11.	12.	13.	13.	14.
15.	16.	16.	17.	17.	18.	19.	19.	20.	21.
21.	22.	22.	23.	25.	28.	101.	313.	615.	1006.
1462.	2043.	1840.	1364.	1220.	1008.	919.	823.	766.	721.
684.	663.	640.	646.	679.	769.	885.	998.	1056.	1064.
1027.	975.	915.	858.	804.	753.	705.	663.	624.	588.
551.	518.	486.	420.	378.	340.	306.	275.	248.	224.
204.	186.	170.	156.	144.	133.	124.	115.	107.	101.
94.	89.	84.	79.	75.	71.	68.	65.	62.	59.
56.	54.	52.	50.	48.	46.	44.	43.	41.	39.
37.	36.	34.	32.	31.	30.	28.	27.	26.	25.
24.	23.	22.	21.	20.	20.	19.	18.	17.	17.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	1.	2.
3.	3.	3.	2.	2.	2.	2.	2.	2.	2.
1.	1.	1.	1.	1.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4
826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4
826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4
826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4
826.4	826.4	826.4	826.4	826.4	826.5	826.6	826.7	826.8	826.9
826.9	827.0	827.1	827.1	827.2	827.2	827.3	827.4	827.4	827.5
827.5	827.6	827.6	827.6	827.6	827.6	827.6	827.6	827.6	827.6

827.6	827.6	827.7	827.7	827.7	827.7	828.5	829.5	830.6	831.5
832.5	833.5	833.1	832.3	832.0	831.5	831.3	831.1	831.0	830.8
830.7	830.7	830.6	830.6	830.7	831.0	831.3	831.5	831.6	831.7
831.6	831.5	831.3	831.2	831.1	830.9	830.8	830.7	830.6	830.5
830.4	830.2	830.1	829.9	829.8	829.6	829.5	829.4	829.3	829.2
829.1	829.0	828.9	828.8	828.7	828.7	828.6	828.6	828.5	828.5
828.4	828.4	828.4	828.3	828.3	828.3	828.2	828.2	828.2	828.1
828.1	828.1	828.0	828.0	828.0	828.0	827.9	827.9	827.9	827.9
827.8	827.8	827.8	827.8	827.8	827.7	827.7	827.7	827.7	827.7
827.7	827.7	827.6	827.6	827.6	827.6	827.6	827.6	827.6	827.6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2043.	880.	261.	221.	37623.
CMS	58.	25.	7.	6.	1065.
INCHES		13.64	16.18	16.20	16.20
MM		346.51	410.92	411.55	411.55
AC-FT		436.	517.	518.	518.
THOUS CU M		538.	638.	639.	639.

MAXIMUM STORAGE = 3.

MAXIMUM STAGE IS 833.5

STATION 2 , PLAN 2, RTIO 3 (OVERTOPPING)

OUTFLOW

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	3.	4.	5.	5.	6.
7.	8.	9.	9.	10.	11.	12.	13.	13.	14.
15.	15.	16.	17.	17.	18.	19.	19.	20.	21.
21.	22.	22.	23.	25.	28.	36.	50.	65.	83.
100.	117.	134.	153.	176.	199.	222.	244.	267.	289.
311.	331.	352.	372.	399.	443.	498.	552.	596.	624.
640.	647.	648.	646.	641.	634.	626.	616.	605.	594.
580.	562.	542.	519.	495.	471.	447.	423.	401.	379.
358.	331.	300.	275.	251.	229.	209.	191.	175.	160.
147.	138.	131.	123.	116.	110.	104.	99.	93.	88.
84.	80.	76.	72.	69.	66.	63.	60.	57.	53.
50.	48.	45.	42.	40.	37.	35.	33.	31.	29.
28.	27.	27.	26.	26.	25.	25.	24.	24.	23.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4
826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4
826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4
826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4	826.4
826.4	826.4	826.4	826.4	826.4	826.5	826.6	826.7	826.8	826.9
826.9	827.0	827.1	827.1	827.2	827.2	827.3	827.4	827.4	827.5
827.5	827.6	827.6	827.6	827.6	827.6	827.6	827.6	827.6	827.6
827.6	827.6	827.7	827.7	827.7	827.7	827.8	828.0	828.2	828.4
828.5	828.6	828.7	828.8	828.9	829.1	829.1	829.2	829.3	829.4
829.5	829.6	829.7	829.8	829.9	830.0	830.2	830.4	830.5	830.6
830.6	830.6	830.6	830.6	830.6	830.6	830.6	830.6	830.5	830.5
830.5	830.4	830.3	830.3	830.2	830.1	830.0	829.9	829.9	829.8
829.7	829.6	829.5	829.4	829.3	829.2	829.1	829.0	828.9	828.8
828.7	828.7	828.6	828.6	828.6	828.5	828.5	828.5	828.4	828.4
828.4	828.3	828.3	828.3	828.3	828.2	828.2	828.1	828.1	828.1
828.0	828.0	827.9	827.9	827.9	827.8	827.8	827.8	827.8	827.7
827.7	827.7	827.7	827.7	827.7	827.7	827.7	827.7	827.7	827.7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	648.	483.	161.	137.	23224.
CMS	18.	14.	5.	4.	658.
INCHES		7.50	9.98	10.00	10.00
MM		190.39	253.41	254.04	254.04
AC-FT		240.	319.	320.	320.
THOUS CU M		296.	394.	395.	395.

MAXIMUM STORAGE = 1.

MAXIMUM STAGE IS 1,830.6

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HYDROGRAPH ROUTING

ROUTE OUTFLOW HYDROGRAPH THRCUGH REACH THREE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	1	0	0	0	0	0	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVT	ELMAX	RLNTH	SEL
.1000	.0400	.1000	757.5	780.0	2800.	.02300

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 780.00 450.00 760.00 550.00 760.00 550.00 757.50 552.50 757.50
552.50 760.00 822.50 760.00 1120.00 780.00

STORAGE	0.00	.19	.38	26.94	59.97	96.37	136.15	179.29	225.80	275.68
	328.93	385.54	445.53	508.88	575.61	645.70	719.17	796.00	876.20	959.77
OUTFLOW	0.00	12.00	29.26	984.78	3434.34	7101.53	11932.57	17922.64	25087.36	33452.74
	43050.63	53916.37	66087.44	79602.62	94501.50	110824.11	128610.68	147901.52	168736.86	191156.81
STAGE	757.50	758.68	759.87	761.05	762.24	763.42	764.61	765.79	766.97	768.16
	769.34	770.53	771.71	772.89	774.08	775.26	776.45	777.63	778.82	780.00
FLOW	0.00	12.00	29.26	984.78	3434.34	7101.53	11932.57	17922.64	25087.36	33452.74
	43050.63	53916.37	66087.44	79602.62	94501.50	110824.11	128610.68	147901.52	168736.86	191156.81

OUTFLOW

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	3.	3.	4.	4.	5.
6.	7.	8.	9.	9.	10.	11.	12.	13.	14.
14.	15.	16.	16.	17.	18.	18.	19.	20.	20.
21.	21.	22.	23.	24.	26.	43.	108.	249.	472.
775.	1289.	1730.	1644.	1406.	1209.	1043.	951.	889.	831.
780.	738.	703.	679.	673.	693.	746.	824.	904.	966.
1007.	1003.	972.	938.	896.	849.	801.	755.	711.	669.
630.	590.	550.	507.	464.	422.	383.	346.	312.	282.
255.	231.	210.	191.	175.	160.	148.	136.	126.	118.
110.	102.	96.	90.	85.	80.	76.	72.	69.	65.
62.	60.	57.	55.	52.	50.	48.	46.	44.	43.
41.	39.	37.	36.	34.	33.	31.	30.	28.	26.
25.	24.	23.	22.	21.	20.	19.	19.	18.	17.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	3.	6.	13.
21.	31.	37.	36.	33.	30.	28.	26.	24.	23.
21.	20.	19.	18.	18.	19.	20.	22.	25.	26.
27.	27.	27.	26.	24.	23.	22.	21.	19.	18.
17.	16.	15.	14.	12.	11.	10.	9.	8.	7.
7.	6.	5.	5.	4.	4.	4.	3.	3.	3.
2.	2.	2.	2.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7
757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7
757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7
757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7
757.7	757.7	757.7	757.7	757.7	757.8	757.8	757.9	757.9	758.0
758.1	758.2	758.3	758.3	758.4	758.5	758.6	758.7	758.7	758.8
758.8	758.9	758.9	759.0	759.0	759.1	759.1	759.2	759.2	759.2
759.3	759.3	759.4	759.4	759.5	759.6	759.9	760.0	760.1	760.4
760.8	761.2	761.4	761.4	761.3	761.2	761.1	761.0	760.9	760.9
760.8	760.7	760.7	760.7	760.7	760.7	760.8	760.9	761.0	761.0
761.1	761.1	761.0	761.0	760.9	760.9	760.8	760.8	760.7	760.7
760.6	760.6	760.5	760.5	760.4	760.4	760.3	760.3	760.2	760.2
760.1	760.1	760.1	760.1	760.0	760.0	760.0	760.0	760.0	760.0
760.0	760.0	760.0	759.9	759.9	759.9	759.9	759.9	759.9	759.9
759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.9
759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.8	759.6
759.6	759.5	759.4	759.4	759.3	759.2	759.2	759.1	759.1	759.1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1730.	868.	261.	221.	37607.
CMS	49.	25.	7.	6.	1065.
INCHES		13.96	16.17	16.20	16.20
MM		341.96	410.75	411.38	411.38
AC-FT		431.	517.	518.	518.
THOUS CU M		531.	638.	639.	639.

MAXIMUM STORAGE = 37.

MAXIMUM STAGE IS 761.9

STATION 3 , PLAN 2, RTIO 3 (OVERTOPPING)

OUTFLOW

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	3.	3.	4.	4.	5.
6.	7.	8.	9.	9.	10.	11.	12.	13.	14.
14.	15.	16.	16.	17.	18.	18.	19.	20.	20.
21.	21.	22.	23.	24.	26.	30.	35.	44.	56.
70.	85.	101.	118.	137.	157.	178.	200.	222.	245.
267.	288.	310.	330.	352.	379.	416.	459.	504.	546.
580.	605.	622.	632.	637.	637.	634.	629.	622.	613.
603.	590.	575.	557.	537.	516.	493.	470.	447.	424.
402.	379.	354.	328.	302.	277.	254.	233.	213.	195.
178.	164.	152.	142.	133.	125.	118.	111.	105.	100.
94.	89.	85.	81.	77.	73.	70.	66.	63.	60.
57.	54.	51.	48.	45.	42.	40.	38.	35.	33.
31.	30.	28.	27.	26.	26.	25.	25.	24.	24.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	1.	1.
2.	2.	2.	3.	3.	4.	5.	5.	6.	6.
7.	8.	8.	9.	9.	10.	11.	12.	14.	15.
16.	16.	17.	17.	17.	17.	17.	17.	17.	17.
16.	16.	16.	15.	15.	14.	13.	13.	12.	11.
11.	10.	9.	9.	8.	7.	7.	6.	5.	5.
5.	4.	4.	4.	3.	3.	3.	3.	2.	2.
2.	2.	2.	2.	2.	2.	2.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7
757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7
757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7
757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7	757.7
757.7	757.7	757.7	757.7	757.7	757.8	757.8	757.9	757.9	758.0
758.1	758.2	758.3	758.3	758.4	758.5	758.6	758.7	758.7	758.8
758.8	758.9	758.9	759.0	759.0	759.1	759.1	759.2	759.2	759.2
759.3	759.3	759.4	759.4	759.5	759.6	759.9	759.9	759.9	759.9
759.9	759.9	760.0	760.0	760.0	760.0	760.1	760.1	760.1	760.1
760.2	760.2	760.2	760.2	760.3	760.3	760.3	760.4	760.5	760.5
760.6	760.6	760.6	760.6	760.6	760.6	760.6	760.6	760.6	760.6
760.6	760.6	760.5	760.5	760.5	760.5	760.4	760.4	760.4	760.4
760.3	760.3	760.3	760.2	760.2	760.2	760.1	760.1	760.1	760.1
760.1	760.0	760.0	760.0	760.0	760.0	760.0	760.0	760.0	760.0
759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.9

759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.9	759.9
759.9	759.9	759.8	759.7	759.7	759.6	759.6	759.5	759.5	759.5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	637.	481.	141.	136.	23203.
CMS	18.	14.	5.	4.	657.
INCHES		7.46	9.97	9.99	9.99
MM		189.36	253.19	253.82	253.82
AC-FT		238.	319.	320.	320.
THOUS CU M		294.	393.	394.	394.

MAXIMUM STORAGE = 17.

MAXIMUM STAGE IS 760.6

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .25	RATIO 3 .50
HYDROGRAPH AT	A1	.60	1	294.	735.	1471.
	(	1.55)	(	8.33)(	20.82)(	41.65)(
			2	294.	735.	1471.
			(	8.33)(	20.82)(	41.65)(
ROUTED TO	A2	.60	1	2045.	2075.	2118.
	(	1.55)	(	57.90)(	58.75)(	59.97)(
			2	114.	362.	648.
			(	3.21)(	10.25)(	18.34)(
ROUTED TO		.60	1	2027.	2052.	2093.
	(	1.55)	(	57.41)(	58.11)(	59.26)(
			2	114.	362.	648.
			(	3.22)(	10.25)(	18.35)(
ROUTED TO		.60	1	1984.	2007.	2043.
	(	1.55)	(	56.18)(	56.84)(	57.86)(
			2	113.	362.	648.
			(	3.21)(	10.25)(	18.35)(
ROUTED TO		.60	1	1646.	1672.	1730.
	(	1.55)	(	46.61)(	47.34)(	48.99)(
			2	112.	353.	637.
			(	3.17)(	10.00)(	18.04)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	837.00	837.00	837.40
STORAGE	198.	198.	215.
OUTFLOW	2.	2.	28.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	837.42	.02	216.	2045.	.44	16.33	15.33
.25	837.50	.10	219.	2075.	.60	14.67	13.67
.50	837.48	.08	218.	2118.	.65	13.67	12.67

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	837.00	837.00	837.40
STORAGE	198.	198.	215.
OUTFLOW	2.	2.	28.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	837.91	.51	233.	114.	7.17	17.33	0.00
.25	838.71	1.31	271.	362.	11.33	17.00	0.00
.50	839.22	1.82	338.	648.	14.17	17.00	0.00

PLAN 1 STATION 1 (BREACH)

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	2027.	841.2	16.33
.25	2052.	841.2	14.67
.50	2093.	841.3	13.67

PLAN 2 STATION 1 (OVERTOPPING)

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	114.	836.4	17.33
.25	362.	839.1	17.00
.50	648.	839.7	17.17

PLAN 1 STATION 2 (BREACH)

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	1984.	833.4	16.33
.25	2007.	833.4	14.67

.50	2043.	833.5	13.67

PLAN 2 STATION 7 (OVERTOPPING)

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	113.	828.5	17.33
.25	362.	829.7	17.00
.50	640.	830.6	17.17

PLAN 1 STATION 3 (BREACH)

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	1646.	761.4	16.50
.25	1672.	761.4	14.83
.50	1730.	761.4	13.83

PLAN 2 STATION 3 (OVERTOPPING)

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	112.	760.0	17.83
.25	353.	760.3	17.50
.50	637.	760.6	17.67

APPENDIX 4

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